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Worldwide Report

TELECOMMUNICATIONS POLICY, RESEARCH AND DEVELOPMENT

No. 258

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BRIEFS

ARAB-JAPANESE CONTRACT--Riyadh, 15 Jan (SPA)--Dr 'Ali al-Mishat [SPA spelling], director-general of the Arab Organisation for Space Communications, today signed a 35-million dollar contract with a Japanese firm for the construction of a network to control Arab satellites. The signing ceremony was attended by the Saudi PTT minister as well as the North Yemeni minister of communications and transport and the chairman of the current session of space communications. In a speech, Dr al-Mishat paid tribute to aid provided by the Saudi Government and reviewed achievements made so far. He said the network was considered the cornerstone for the Arab satellite project. In turn, Saudi PTT Minister Dr 'Alwai Darwish Kayyal stressed the importance of the network and described the occasion as memorable. [Text] [LD152132 Riyadh SPA in English 2058 GMT 15 Jan 83]

CSO: 5500/4515

BRIEFS

USE OF FRENCH SATELLITE--Yogyakarta, December 1 (ANTARA)--Indonesia will take part in the utilization of the French made 'Spot' satellite which is scheduled to be launched into its orbit in 1984. In relation with the plan to cooperate with France in the utilization of the 'Spot' satellite, a workshop on the application of remote-sensing system is being held here on November 30 and December 1. [Jakarta ANTARA in English 0908 GMT 1 Dec 82 BK]

CSO: 5500/4325

SATELLITE COMMUNICATION EXPERIMENT 'SUCCESSFUL'

OW301918 Beijing XINHUA in English 1630 GMT 30 Oct 82

[Text] Shanghai, October 30 (XINHUA) — China has reported "complete success" with its first domestic satellite communications and T.V. transmission experiments involving ten ground stations, five of which were domestically designed and equipped, XINHUA learned today.

The Ministry of Posts and Telecommunications recently called a meeting in Shanghai to discuss the experimental use of a satellite of the International Telecommunications Satellite Organization (Intelsat) over the Indian Ocean region.

The experiment, which began on June 5 and ended on October 5, was characterised by experts as a "complete success". It is viewed as a first step towards establishing a full-fledged national satellite communications network and setting up ground stations in such remote regions as Tibet.

As a result of the experiment, said Zhu Chun, advisory to the ministry, "China acquired valuable experience in operating satellite communications facilities."

In the course of the experiment, the Beijing and Shanghai ground stations transmitted live telecasts of news, sports, and other programs to Xinjiang and Inner Mongolia, two remote regions, for over a month. Reception was reportedly excellent.

In addition to T.V. signals, the feasibility of transmitting telephone, telegraph, facsimile and data was verified.

Ten ground stations participated in the experiment. Of these, five were domestically designed and built and use Chinese equipment. These had passed Intelsat tests before they were put to use.

CSO: 5500/4111

UN COMMITTEE APPROVES TELEVISION SATELLITE PLAN

OW230343 Beijing XINHUA in English 0236 GMT 23 Nov 82

[Text] United Nations, November 22 (XINHUA) -- The U.N. special political committee approved today a set of draft principles for governing international direct television broadcasting by satellite which have been under negotiations for years.

A draft resolution which contains these principles stresses that access to the technology in this field should be available to all states without discrimination on terms mutually agreed by all concerned.

It provides that "a state which intends to establish or authorize the establishment of an international direct television broadcasting satellite service shall, without delay, notify the proposed receiving state or states of such intention and shall promptly enter into consultation with any of those states which so request."

International direct television broadcasting by satellite should be carried out "in a manner compatible with the sovereign rights of states, including the principle of non-intervention as well as with the right of everyone to seek, receive and impart information and ideas as enshrined in the relevant United Nations instruments," (?the resolution) adds.

The draft resolution was supported by most developing countries, but opposed by certain developed countries. The draft resolution will be submitted to the U.N. General Assembly for adoption.

CSO: 5500/4111

GUANGDONG TO INVEST MORE IN COMMUNICATIONS

HK260452 Guangzhou Guangdong Provincial Service in Mandarin [no time given] 25 Nov 82

[Text] Resolutely implementing the 12th Party Congress spirit, Guangdong is vigorously tackling communications and transport--a strategic focus--by increasing investment and starting work on various key projects. Apart from the 2 billion yuan in state investment and bank loans for the double-tracking of the Hengyang-Guangzhou section of the Beijing-Guangzhou railroad, the province plans to raise over 1.1 billion yuan in the next 3 years from state investment, bank loans, technical improvement expenditures, profit from enterprises, local fund-raising, foreign investment and so on to develop transport, posts and telecommunications. Never since liberation has the province invested so much in these undertakings.

At present work on a number of key transport, posts and telecommunications projects is in full swing or about to start. These projects are as follows: the double-tracking of the Hengyang-Guangzhou section of the Beijing-Guangzhou railroad; construction of the Sanshui-Yaogu section of the Guangzhou-Maoming railroad; expansion of 13 stations on the Guangshou-Shenzhen railroad; improvement of 10 main roads; construction of 15 new road bridges; expansion of ports at Guangzhou, Huangpu, Zhanjiang, Shantou, Qinglan and Sanbaimen; tidying up the Dongping waterway and various shallow spots on the Xijiang River at (Panlong), (Jieshou), Dule and (Xintan): construction of three satellite telecommunications group stations at Guangzhou, Zhanjiang and Shantou; construction of microwave links from Guangzhou to Shenzhen, Haikou, and Shantou; improvement of urban telephone services in Guangzhou, Shenzhen, Zhuhai and Shantou; and provision of a further 80,000 automatic telephones by 1985.

CSO: 5500/4110

ULANHU ARTICLE ON BROADCASTING, TELEVISION

OW021253 Beijing Domestic Service in Mandarin 0400 GMT 30 Oct 82

[Article by Ulanhu for the ZHONGGUO GUANGBO DIANSHI [CHINA RADIO AND TELEVISION] journal: "Radio and Television Programs Should Better Serve the People of All Nationalities" -- issue number not given]

[Text] On the occasion of the 42d anniversary of the founding of our people's broadcasting service, the Ministry of Radio and Television and the State Nationalities Affairs Commission have decided to solicit articles on the unity of various nationalities throughout the country in order to promote the work among various nationalities, to bring about a new situation in this regard and to strengthen the unity of all nationalities. This is a major happy event, to which I extend my warm congratulations. I hope that this meaningful activity will be completely successful.

Ours is a unified multinational country with a large population. In addition to the Han nationality, our country has 55 minority nationalities with a total population of over 60 million distributed over more than 50 percent of the vast area of our country. With the development of socialist construction, tremendous developments have been made in our people's broadcasting service according to the needs of various nationalities over the past 42 years. There are now broadcasting and television stations at the seat of the central government as well as in various provinces, municipalities and autonomous regions. A wired broadcasting network has been set up in the countryside. The Central People's Broadcasting Station and some provincial and autonomous regional broadcasting stations have started a number of minority language programs.

The broadcasting and television services have played an important role in publicizing the party's principles and policies, promoting the unity of all nationalities, strengthening the economic relations and cultural exchanges among various nationalities, encouraging the people of various nationalities to carry out socialist construction and consolidating our national defense. Now broadcasting and television programs have increasingly become an indispensable nourishment for the minds of the people of various nationalities in their daily life.

In his report to the 12th party congress, Comrade Hu Yaobang emphatically pointed out: Unity, equality and common prosperity among the nationalities are of vital importance to the destiny of China as a multinational country.

In bringing about a new situation in all fields of socialist modernization, accelerating the economic and cultural development of the areas inhabited by minority nationalities is an important part of the efforts to achieve socialist modernization in our country.

For historical reasons, the majority of our minority nationalities live in vast border areas where transport facilities are poor and economic and cultural conditions are rather backward. The task of building a high degree of socialist material and spiritual civilization in those border areas is more arduous than that in the interior. Therefore, they need support and assistance from the state and the interior in various aspects.

As modern effective propaganda media, broadcasting and television can directly reach thousands of distant nationalities faster and more extensively than other propaganda media. Therefore, better broadcasting and television services should be provided for the people of various nationalities in order to publicize the party's nationality policy, to further conduct education on the unity of all nationalities, to increase the exchange of experiences by various nationalities in undertaking the four modernizations, to promote the economic and cultural development of the areas inhabited by minority nationalities and to build a high degree of socialist material and spiritual civilization. To this end, I earnestly hope that comrades on the broadcasting and television front, inspired by the guidelines of the 12th party congress and under the leadership of the party Central Committee and party committees at various levels, will further heighten their revolutionary spirit, strengthen their ranks, improve their technology and equipment and solve as soon as possible the problem of unavailability or poor quality of broadcasting and television services in some remote areas inhabited by minority nationalities. They should make their broadcasting and television programs richer and more colorful in content in order to meet the urgent needs of minority and other nationalities throughout the country as well as the requirements of the developing situation in socialist construction in the new period. This is an important and glorious task in bringing about a new situation in the broadcasting and television services.

CSO: 5500/4110

REGULATIONS ON PROTECTING COMMUNICATIONS LINES

OW051443 Beijing XINHUA Domestic Service in Chinese 0727 GMT 4 Nov 82

[Text] Beijing, 4 Nov (XINHUA)--The State Council and the Military Commission of the CPC Central Committee recently issued a document entitled "Regulations on Protecting the Lines of Telecommunications," which calls on the posts and telecommunications, railway and public security departments at all levels to act in close coordination with PLA units and under the unified leadership of local party committees and governments to mobilize the masses in a fight against acts of damage and theft of telecommunications lines and equipment so as to protect these lines and equipment in a practical way and ensure their smooth and unimpeded message tranmissions.

Telecommunications lines constitute an important component part of the communications network of the state. They shoulder the task of transmitting orders of leading party, government army organs at various levels, facilitating the control and dispatch of railway transport trains and offering domestic and international communications needed by the party, government, army and people. They have an important role to play in socialist modernization as well as in strengthening national defense.

According to the "regulations," telecommunications lines and equipment include all of the following: poles, wires and cables of the overhead transmission lines installed by the posts and telecommunications, railway and army departments; underground and submarine pipelines and cables of buried transmission lines; unmanned microwave stations and transmitter and receiver antenna of radio transmission lines, antenna for microwave and satellite communications ground stations; as well as various kinds of accessory equipment of the above transmission lines.

The "regulations" call on people's governments at all levels to strengthen leadership and frequently carry out propaganda and education work concerning the protection of telecommunications lines. Telecommunications departments at all levels should improve their maintenance and management of the telecommunications lines by rigidly practicing the individual responsibility system and various kinds of relevant rules and regulations. All offices, mines, factories, PLA units, schools, rural communes and brigades along the trnasmission lines as well as the masses of people living nearby have the responsibility to protect the safety of the telecommunications lines in their areas.

The "regulations" prohibit any of the following: detonation or stacking of explosive or flammable articles within an area in which the safety of the telecommunications lines may be endangered; drilling, stacking of heavy and bulky articles, garbage or slag or pouring of liquids of acid, alkaline or saline content on the ground where an underground cable is buried; anchor dropping, anchor dragging, fishing or other operations that may endanger the safety of cables within the area where the presence of a cross-river cable is marked or within 2 nautical miles from either side of a marker on the sea that indicates the location of a submarine cable; erection of houses or shacks within 1 meter from either side of an underground cable; digging up of sand or earth and installation of toilets, manure pits, animal pens, methane-generating pits or any other corrosion-causing structures within 3 meters from either side of a cable; moving, damaging or climbing an electric-wire pole, its props or other equipment; and suspension from or connection to a telecommunications line of a broadcast speaker or a radio or television antenna. Every unit and every person among the masses has the right to stop any act of sabotage of a telecommunications line or any other act that endangers the safety of telecommunications line or any other act that endangers the safety of telecommunications transmissions, and to make a timely report to the local public security or telecommunications departments.

The "regulations" state that any unit or individual that has caused damage to a telecommunications line and the suspension of transmissions through the line should be held responsible for the act. This ranges from paying for the repair of the damaged line, to compensation for the economic losses incurred by the suspension of telecommunications transmissions, to undergoing investigation to affix the responsibility for the criminal act. Anyone who steals an electric wire pole, electric wires, cables or other telecommunications equipment, or endangers telecommunications safety through technical means is considered to have committed a crime. Cases of sabotage of telecommunications lines bv counterrevolutionary elements or other criminals should be cracked down on in good time and dealt with in accordance with the law by the public security and judicial organs. Salvage stations handling retrieval of waste material must not purchase any telecommunications equipment sold by robbers and theives. They should also report what they have found to the public security organs or telecommunications departments.

The "regulations" state that commendations or rewards should be given to any unit, collective or individual that has made remarkable achievements in protecting telecommunications lines. preventing damage incidents, helping in solving a case, capturing a criminal, retrieving stolen equipment or assisting in the repair of telecommunications lines.

CSO: 5500/4110

BRIEFS

GUANGDONG SATELLITE GROUND STATIONS--With the approval of the State Council the Ministry of Posts and Telecommunications recently decided to build satellite telecommunications ground stations at Guangzhou, Zhanjiang and Shantou, to improve the province's internal and external telecommunications. The Guangzhou station is planned to be completed and in operation by the end of next year. These three stations will provide high-standard telecommunications services for South China Sea Oil exploitation and for the meteorology, electric power, press and other departments. When the projects are completed and in operation, the province's telecommunications will be greatly improved. The facilities will be able to receive and transmit color television programs, create conditions for increasing the number of television channels in the future, and also pave the way for linking up with the international satellite telecommunications network. The work of drawing up designs for the Guangzhou station has now been completed. [Text] [HK180543 Guangzhou Guangdong Provincial Service in Mandarin 2350 GMT 17 Nov 82]

URUMQI SATELLITE COMMUNICATIONS STATION--The Urumqi satellite ground communications station was recently completed and handed over for experimental use. According to investigations by experts and engineers of state council departments concerned, such as the television ("engineering") department, the equipment fully meets the demands of the design. The Urumqi satellite ground communications station is a permanent ground station in China's first satellite telecommunications network. It will handle telecommunications, radio and television relays and newspaper facsimile transmission. All the equipment was designed and made in China. Work on constructing the station began in 1978. The preparatory construction was completed in October 1979. Installation of equipment began on 27 July last year. The engineers and technicians taking part in the work overcame many difficulties, worked hard with concerted efforts, and completed the installation work 2 weeks ahead of schedule. On the afternoon of 5 November responsible comrades of the regional party and government and the Urumqi PLA units Wang Enmao, Xiao Quanfu, Tan Youlin, Tomur Dawamat, Huang Luobin, and Janabil met in the [word indistinct] guesthouse the representatives who had taken part in acceptance work for the station. Comrade Wang Enmao thanked them on behalf of the people of all nationalities in the region, and wished them new success in science and technology work. [Text] [HK060310 Urumqi Xinjiang Regional Service in Mandarin 1300 GMT 5 Nov 82]

GUIZHOU TV NETWORKS--In order to speed up the development of Guizhou's television broadcasting in a planned way, the provincial broadcasting bureau held a conference to discuss technical plans for Guizhou's television broadcasting transmission networks in Guiyang 24-31 October. Participating in the conference were some 200 technicians and responsible members of broadcasting bureaus of various prefectures, autonomous prefectures, municipalities and counties. They carefully studied technical policies, technical standards and methods for planning the television transmission networks and, in light of Guizhou's reality, discussed questions concerning how to draw up technical plans for Guizhou's television transmission network, such as planned and scientific arrangements for the layout of television relay stations, channel allocation, how to avoid interference and so on. The conference drew up plans for two television transmission networks in Guizhou, plans for relaying the two sets of television programs transmitted by the central television station and plans for a ground station to receive broadcasts via satellite. The long-term goal of the technical plans of the television transmission networks is to transmit television to about 95 percent of Guizhou's population, that is, to ensure that on the whole all the people in Guizhou will be able to watch television. Those who attended the conference had full faith in fulfilling the task of drawing up technical plans for the television transmission networks and in realizing them. They expressed their determination to make contributions to speeding up Guizhou's television development. [Text] [HK041104 Guiyang Guizhou Provincial Service in Mandarin 1100 GMT 3 Nov 82]

COMMUNICATION SATELLITE EXPERIMENTS--According to WEN HUI BAO, China conducted its first experiment in using international communication satellites for domestic satellite communication and TV transmission from 5 June to 5 October this year. The experiment was successful and has laid the technical and material foundations for establishing a satellite communication network in the country. Recently the Ministry of Posts and Telecommunications held a meeting in Shanghai to sum up the work of the experiment. In accordance with the needs of national construction and communications, more ground stations are scheduled to be built in Xinjiang, Nei Monggol, Xizang and other frontier provinces and cities. [Text] [OW280152 Shanghai City Service in Mandarin 2300 GMT 27 Oct 82]

ZHEJIANG TV RELAY STATIONS--The Zhejiang provincial broadcasting affairs bureau held a meeting in Ningbo Municipality from 12 to 19 October to discuss the management and planning of the province's low-power TV relay stations. The province has high- and medium-power backbone TV relay stations of more than 1 KW using VHF channels 1 to 12, and has more than 300 TV relay stations of less than 50 watts. Fifty percent of Zhejiang's population can now watch the Zhejiang TV station's programs with good reception; 30 percent can watch the central TV station's programs with good reception. The meeting summed up and exchanged experience in the planning, construction and management of the province's low-power TV relay stations in the past 10 years. It also unified standards and requirements in TV planning and conducted a study on the TV planning work in the province. [Hangzhou Zhejiang Provincial Service in Mandarin 1030 GMT 1 Nov 82 OW]

CSO: 4110

FUJIAN MICROWAVE TELEVISION CIRCUIT--Fuzhou, 27 Oct (XINHUA)--China's first across-sea microwave television circuit has opened in Fujian Province, serving the coastal southern part of the region, according to the provincial broadcasting administration. The 303-kilometer circuit originates at the Fujian T.V. station in Fuzhou, provincial capital, and transmits to Xiamen, with seven microwave stations in Fuzhou, Pingtan Island and other places. Using domestically-made equipment, the circuit was designed and installed by the provincial broadcasting administration. The administration plans to extend the circuit to western Fujian and use it for radio transmission next year. [Text] [OW290155 Beijing XINHUA in English 0826 GMT 27 Oct 82]

MORE NEWS ON RADIO BEIJING--(XINHUA)--The Central People's Broadcasting Station recently made some adjustments on its first and second programs and worked out a new program schedule to be put into effect on New Year's Day 1983. The number of newscasts in the two programs will increase from 19 to 24 each day, averaging one newscast every hour. [Text] [Beijing GONGREN RIBAO in Chinese 27 Dec 82 p 2]

CSO: 5500/4115

TELECOMMUNICATIONS AUTHORITY PLANS BUYING ERICSSON EXCHANGES

Stockholm SVENSKA DAGBLADET in Swedish 4 Dec 82 p 31

[Text] L.M. Ericsson has gotten a big new order from Southeast Asia. The concern has secured a "letter of intent" from the Thai telephone authority having to do with a total of 350 million kronor's worth of AXE [expansion unknown] exchanges.

The Thai telecommunications authority intends to buy a total of 82 AXE exchanges, which will be used to modernize the telecommunications net in a number of provincial towns. The equipment will be manufactured entirely at Ericsson's Swedish factories. The shipments and installation will be done in 1984 for the most part.

Ericsson also got an order recently for a larger AXE exchange for international traffic to and from Bangkok, the capital.

Comeback

For the Swedish concern the orders represent a comeback on the Thai market.

Since the end of the 1960's that market has been dominated by Japanese firms, despite the fact that Ericsson had a strong position there earlier.

During the last few days Ericsson has also gotten the first order from South Korea within the framework of the "letter of intent" for 80 million kronor signed earlier. The order is for six long-distance exchanges and is worth 300 million kronor.

Hong Kong, Too

New opportunities are opening up for the Swedish telecommunications firm in Hong Kong, too. The Hong Kong Telephone Company has decided to invest over 6 million kronor in an expansion and modernization of the telephone net.

The investments will be made primarily in fiber-optical systems and digital telephone exchanges. In 1983 alone 800 million kronor will be invested.

Up to now Ericsson has sold its AXE system to 45 countries. Nearly 6 million lines have been installed or ordered.

8815
CSO: 5500/2584

TRENDS IN TELEPROCESSING OUTLINED

Prague TELEKOMUNIKACE in Czech No 10, Oct 82 pp 148-150

[Article by Eng Josep Puzman, CSc, Federal Misistry for Technical and Investment Development: "Trends In Teleprocessing"]

[Text] By teleprocessing [DZD] systems, we mean complex systems and networks connecting the points of origin of primary data with the locations where the data are processed and used, along with all processing and transmission activities. The individual points are so located that they require transmission by telecommunications facilities (thus we are not dealing with systems in one building or on a single site, which are "local" processing networks). DZD systems include computer centers with teleprocessing, complexes of computers and data bases distributed over a large area, and terminal and computer networks.

The importance of DZD systems for management of the national economy, and more recently for the needs of the public, is unquestioned, and is confirmed in the document, "Guidelines of the Economic and Social Development of Czechoslovakia" for the current 5-year plan period, which was approved by the 16th CPCZ Congress. Only effective utilization of these systems in management will make it possible to fully carry out the decrees of the CPCZ Central Committee Presidium and the CSSR Government regarding improvement of the system for planned management of the national economy.

In this article we will survey the status of DZD systems and trends in their installation and utilization and will compare the developed West European countries (the United States, Canada and Japan will not be discussed because of their different characteristics) with Czechoslovakia.

Because DZD cannot be considered separately from data processing itself, and thus from computer hardware, we will first undertake to evaluate the status of installation of computers. By the end of 1980 a total of 1,457 computers were in operation in Czechoslovakia; 26.6 percent were large (with an operational memory of over 128 Kbyte), while 61.9 percent were medium-sized (32 to 128 Kbyte). But on the same date there were only 2,551 terminals in operation (including remote terminals), giving an average of 1.75 terminals per computer;

the number and proportion of network terminal points* were even lower (1,157 terminal points, or 0.79 per computer). While the processing capacity of computers now in operation is sufficient to handle demanding work related to the management of the national economy, the low proportion of DZD arrangements indicates either the users do not place sufficient reliance in the speed of transmission of data from the points at which they originate to the processing location and from there to the point of use, or that they are not fully aware of the positive economic effects of DZD. There is, of course, yet another reason, a basic one, for the slow rate of development of DZD in Czechoslovakia: most computers now in operation do not have the requisite communications facilities for remote transmission, and only the introduction of the new series of JSEP [Unified System of Computers] and SMEP [System of Small Computers] computers will pave the way for faster development of teleprocessing.

However, in evaluating the use of teleprocessing we must not neglect the fact that the beginnings of remote data transmission in Czechoslovakia date from the time when the Czechoslovak Office of Communications began to serve computer users, a time when the advanced capitalist countries (The United Kingdom, FRG, France) had as many network terminal points in operation as Czechoslovakia has now. The number of such points installed in the West European countries in the last 10 years has increased by a factor of about 3.5, while the growth factor for Czechoslovakia over the same period has been nearly 25, with an understandable falling trend (e.g., the index for 1980/1979 was 0.22 and that for 1981/1980 was only 0.15).

Let us evaluate the density of installed network terminal points just as we do when tracing the growth of installed teletypewriter or telephone stations. In contrast to the latter, the number of which depends on the number of inhabitants, it is most suitable to relate the number of network terminal points only to the number of workers (the use of teleprocessing by the public is just beginning), giving the number of points, say, per 1,000 workers. From this viewpoint, Sweden is far ahead in first place, with a density of 5.7 points per 1,000 workers, while the average in Western Europe is 3.5. In Czechoslovakia, the density of network terminal points is 0.16, the density of all terminals is 0.35, and that of computers is 0.2, per 1,000 workers.

Teleprocessing is not an end in itself, but directly serves more efficient data processing in an extremely wide range of sectors of the economy. It is of some interest to take note of the proportions of the individual sectors using DZD (Table 1). The Western European countries use DZD primarily in finance, followed by industry, commerce, government administration, education and research, with other sectors, including transportation and health, having a small share (less than 6 percent).

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* By "Network terminal point" we mean the termination of data line, e.g. in a modem, to which the user's transmission and processing equipment is connected.

Table 1. Installed Terminals in Various Sectors

Sector	1979 Number	1979 %	1987 Number	1987 %
Money and banking	116000	29,6	437000	27,1
Production control	42800	10,9	173000	10,7
Computer services	39600	10,1	119000	7,4
Manufacturing process control	35700	9,1	133000	8,2
Retail and wholesale trade	35400	9,0	164000	10,1
State administration	32200	8,2	137000	8,5
Other industrial	25600	6,5	142000	8,8
Education and research	23400	6,0	80900	5,0
Public services	18600	4,7	130000	8,0
Land transport	6840	1,8	35700	2,2
Air transport	6360	1,6	12500	0,8
Insurance	5860	1,5	33100	2,0
Health	3700	1,0	18800	1,2

The breakdown is somewhat different in Czechoslovakia. The largest holdings of computers, terminals and modems are in industry (about 45 percent), followed by state administration (15 percent)--as a result of the different method of administration, then by agriculture and computer services (in terms of the proportion of computer equipment involved, DZD does not figure very importantly in computer services), commerce, transport, finance and the like. In addition to industry and state administration, DZD is also beginning to be introduced into education and research (more than 8 percent), finance (more than 6 percent, obviously affected by the relatively large SBCS [Czechoslovak State Bank] network), commerce (5.6 percent), transport and communications.

Understandably, DZD systems in different sectors require different types of terminals (local and remote). Table 2 gives a very detailed breakdown of types of terminals and levels of utilization in Western Europe. The largest share (more than half) goes to alphanumeric display terminals, indicating DZD's predominant orientation toward interactive operation and real-time control. In Czechoslovakia, the statistical breakdown is not so detailed, but data for 1980 indicate that 45 percent of the terminals in use were alphanumeric display terminals and 46 percent were teletypewriter terminals (compared with 17.4 percent for all teletypewriter terminals in Western Europe). Thus the breakdown of terminal use not only reflects user needs, but is also considerably affected by the selection of available hardware.

As regards transmission facilities, the breakdown in use of transmission speeds is interesting. Table 3 again presents data for all Western European countries, but the statistics are not complete as a result of differences in reporting from country to country (for example, in the United Kingdom private signal converters connected to a leased line are not considered; in the case of speeds above 2,400 bps [bits per second] this is also true for switched lines, since the utilities are not involved in these areas). Regardless of this source of

inaccuracy, it can be seen from the table that most equipment has speeds under 1,200 bps. But a more detailed analysis for the individual countries indicates a number of variations, e.g., in France more than 14 percent of the modems in use are extremely fast ones, as a result of the beginning of operation of the CADUCEE network of wideband lines and the TRANSPAC public packet-switching network.

Table 2. Use of Terminals for Teleprocessing by Type

	1979		1987	
Terminal Type	Number	%	Number	%
Teletypewriters, 10 cps*	65000	5,1	6000	0,1
Teletypewriters, 10-30 cps	156000	12,3	696000	11,6
Alphanumeric display terminals	658000	51,8	3530000	58,7
Batch terminals with character printer	165000	13,0	768000	12,8
Batch terminals with line printer	129000	10,1	282000	4,7
Other batch terminals	18000	1,4	65000	1,1
Graphic display terminals	9000	0,7	45000	0,8
Facsimile equipment	4000	0,3	116000	1,9
Special dedicated equipment	25000	2,0	90000	1,5
Transmission	5000	0,4	120000	2,0
Other	37000	2,9	290000	4,8

*cps = Characters per second

Table 3. Use of Transmission Speeds

	Percent in use	
Speed	1979	1987
Less than 300 bps	38	17
300-1200 bps	30	22
2400 bps	17	28
4800 bps	10	12
9600 bps or more	5	21

In Czechoslovakia, the proportion of equipment with transmission speeds up to 200 bps is 38.3 percent, while between 600 and 1,200 bps it is 43 percent. However, these data are somewhat limited by the fact that remote data transmission on switched Telex networks is not taken into account. Very little use is made of speeds above 1,200 bps in Czechoslovakia (11 percent at 2,400 bps and 2.9 percent at 4,800), as a result of the shortage of suitable signal converters (the users must import them after suitable coordination with the Czechoslovak Office of Communications).

Also related to transmission speed is the use of transmission media. Table 4 shows the numbers and relative proportions of network terminal points connected

to four types of media: in Western Europe most use is made of leased lines, and the public data networks are the least used. In this respect, the situation is almost exactly the same in Czechoslovakia: 53 percent of network terminal points are connected to leased lines and 45 percent to switched lines, while the remainder are network terminal points operating in the circuit-switched integrated telegraphic network.

Table 4. Use of Transmission Media for Teleprocessing

Transmission medium	1979 Number of terminal points	1979 %	1987 Number of terminal points	1987 %
Leased lines	233000	59	778000	49
Public telephone system	151000	38	333000	20
Circuit-switched public data communications system	3000	1	175000	11
Packet-switched public data communications system	6000	2	331000	20

Finally, we must not neglect the effect of the public data networks which are now arising, even though, as Table 4 indicates, in 1979 they accounted for a negligible proportion of the types in use. Nonetheless, although in the early years all data transmission was carried by the teletype and telephone network, construction of public data networks using circuit switching or packet switching (and less frequently message switching) began a relatively long time ago. The first public data network was the RETD network of the Spanish communications bureau, which has been operating in the packet-switching mode since 1971. Others worthy of note are the DATEX-L circuit-switched network and the later DATEX-P packet-switched network in West Germany, the TRANSPAC network already mentioned, the PSS packet-switching network of the British Office of Communications, which developed out of experience with the EPSS experimental network, and two public data networks spanning several countries: the Scandinavian network operated by the communications offices of Denmark, Finland, Norway and Sweden, using circuit switching, and the packet-switched EUROMET network, which now includes all Western European countries and has also access to the United States and Canada.

While Czechoslovakia is about 10 years behind the most advanced capitalist countries in terms of the number of installed network terminal points and in their density, the breakdown of use of remote data processing (terminals, speeds, transmission media) is practically the same. This indicates a good base which can be further developed if Czechoslovak industry will pave the way for expanding the selection of terminal and transmission equipment

We now turn our attention to the development of DZD in the last 5 years. Certain shifts are beginning in the use of DZD in the various sectors (Table 1). In addition, there will be a partial change in the breakdown of types of data transmitted. The annual increase in data operations expected to be 28 percent, and the rate of increase in the number of calls (connections) will be about

the same, while their length is expected to decrease (by 11 percent annually). These estimates indicate an attempt to exchange data more rapidly and efficiently, even with current transmission media.

In addition, there will be an increase in the percentage of alphanumeric display terminals, and there is also expected to be an increase in the number of facsimile devices (for the Teletex service) and transmission terminals, at the expense of teletypewriter terminals (Table 2).

While in 1979 transmission speeds below 1,200 bps predominated, in the future a shift to higher speeds is expected (Table 3). While even now the most common speed for transmission equipment is 1,200 bps, in 1987 a speed of 2,400 bps is likely to be most common. It is also apparent from Table 3 that there will be increased use of a speed of 9,600 bps while the speed of 4,800 bps will not be so important. This forecast is based on the fact that the price of a 9,600-bps modem is not much different from that of a 4,800-bps modem and both types are capable of multiplexed operation with slower terminals, so that the user will prefer the transmission equipment which gives him the cheapest service.

We now consider the utilization of transmission media. With the continuing creation of public data networks it is expected that data operation will become increasingly important. Nonetheless the forecast (Table 4) is that most data operation will continue to be on leased lines, particularly telephone and broadband lines.

In conclusion, we consider the effect of new transmission and data conversion hardware on the construction of DZD systems. As the foregoing discussion indicates, there is currently an attempt to make maximum use of transmission capacities. Accordingly high-speed modems for multiplex operation are being designed and the public data networks are accordingly trying to make the most effective use of expensive transmission equipment and lines, with the result that they are seeking the widest band communications media. This is of course the trend throughout telecommunications.

High speed can be attained on present-day telecommunications media (e.g., telephone lines) by new modulation and receiving methods, and by automatic matching of transmission characteristics, which requires complex interfacing; accordingly, modern signal converters are equipped with microprocessors. In addition, new communications media allowing extremely fast transmission, on the order of megabits per second, are being sought. One such system is optical fibers and cables, which, together with digital multiplex systems (e.g., with pulse code modulation), have this capability. To be sure, such high speeds are not the most suitable for data transmission. There is still no optical communications systems exclusively intended for remote data transmission, with the exception of the Mercury project in the United Kingdom for several corporations (Barclay Merchant Bank, British Petroleum), which is to go into operation next year, using optical transmission, among other facilities. But the transmission rate will be only about 64K bps. However, the optical media are sure to gradually take on transmission of all types of information, including digital data in integrated networks.

Packet switching arose at a time when the existing communications systems of public communications networks were not the most suitable for data. The switching nodes in packet switching are based on computers with large-capacity memory systems and communications-oriented software. New types of exchange with channel switching, particularly electronic exchanges, but also including computers, are likewise capable of providing a much wider range of services than the original relay exchanges. Accordingly, it is no wonder that there is currently some disagreement as to which method of switching should be chosen for data networks and both packet-switching and circuit-switching networks are operating side by side.

We have attempted to outline the trends of development of communications in teleprocessing systems. We chose rather a near horizon, 1987, because in such a rapidly developing field long-term forecasts are extremely difficult.

8480
CSO: 5500/3017

CARIBBEAN NEWS AGENCY REQUIREMENTS NOTED BY OAS CHIEF

Bridgetown ADVOCATE-NEWS in English 4 Dec 82 p 3

[Text] ROSEAU, Dominica, Friday, (CANA) — The Barbados headquartered Caribbean News Agency (CANA) should be provided with funding to help bridge the information gap between English and Spanish-speaking countries in the region, Val McComie, Assistant Secretary General of the Organisation of American States (OAS) said here.

Mr. McComie told a news conference that the gap could be narrowed if CANA — set up in 1976 to serve the English-speaking Caribbean — could operate in Spanish as well, to serve Latin America.

The Assistant Secretary General said ".....If this was done it would be possible for the major newspapers in Latin America to subscribe to CANA.....and it would be left to the editors to decide on a day-to-day basis what to use on the Caribbean and certainly this is something vitally important....."

Mr. McComie said however that he felt that for CANA to operate a Spanish service, this could raise the question of Latin American governments supporting the news service.

".....I think there is a strong feeling about governments having anything to do with a news service, because it would assume automatically some sort of control or censorship of the news....." Mr. McCommie continued.

He said however that since the agency was set up six years ago with Caribbean governments contributing to its operation, it appeared there had been no government interference.

Mr. McComie also said the Inter-American Commission on Human Rights (ICHR), an OAS affiliate, has received allegations of human rights violations in Grenada from a number of regional newspapers.

He said that the commission had since then been in touch with the Peoples Revolutionary Government (PRG) in Grenada to arrange for a visit by an official team to investigate the allegations.

"As far as I am aware there has been a denounciation of violations of human rights in Grenada made by a group of newspapers and the commission has been in touch with the government of Grenada to arrange for.....visits."

He did not name the newspapers.

During last month's Caribbean Community (CARICOM) heads of Government summit five newspapers, the **Advocate-News** and Nation in Barbados, Jamaica's Gleaner and the Guardian and Express in Trinidad and Tobago carried identical editorials condemning alleged human rights violations in Grenada and Guyana.

CSO: 5500/7518

BRIEFS

SATELLITE TELECOMMUNICATIONS SYSTEM--The general administrator of the National Telecommunications Company has dedicated a new national satellite telecommunications system called "Soberania Nacional." This new system will make it possible to connect isolated localities with urban centers. [PY262015 Buenos Aires Domestic Service in Spanish 1030 GMT 23 Dec 82]

SATELLITE COMMUNICATIONS CIRCUITS INCREASED--Satellite communications circuits with Brazil, Venezuela and Greece have been increased, the chairman of ENTEL [National Communications Company] has reported. ENTEL, he explained, has started operating 9 circuits to Caracas, 5 to Athens and 10 to Rio de Janeiro and Sao Paulo. [Buenos Aires Domestic Service in Spanish 2000 GMT 20 Dec 82 PY]

CSO: 5500/2025

PHONE COMPANY, CABLE & WIRELESS SETTLE 3-YEAR DISPUTE

Revenue-Sharing Provision

Bridgetown ADVOCATE-NEWS in English 18 Dec 82 p 1

[Text] **International telephone revenue will now be divided on a 50-50 basis between the Barbados Telephone Company Limited and Cable and Wireless West Indies Limited.**

Cable and Wireless has also agreed to make an ex-gratia payment of five per cent of 1981 international telephone revenues to the telephone company. This represents a figure of Bds$1.275 million.

These announcements made by Senator Nigel Barrow yesterday signalled the end of a three-year dispute between the companies. The solution was reached after just three weeks of talks between the companies and Mr. Tom Weaver, financial advisor with the International Telecommunications Union who was in Barbados at the request of the Government.

Senator Barrow, who is Minister responsible for telecommunications, also received a report on telecommunications in Barbados from Mr. Weaver.

He said that the 50-50 division ratio to which the companies had agreed would be applied over a five-year period in the first instance ending in 1987 by which time it is expected that a new basis for providing telecommunications services would have been worked out.

Senator Barrow said that new arrangements for telecommunications services would be discussed early in the New Year.

In a background to the dispute, the Minister noted that at the start of the dispute in 1979 the ratio division between the companies had been 70-30 in favour of Cable and Wireless.

He said that after legislation in 1980, the Minister set the ratio division at 60-40, an interim move, pending Mr. Weaver's advice.

He said that the settlement ushered in a new era of co-operation between the companies.

The companies have agreed that all the international accounting will be handled by Cable and Wireless.

They have also agreed to co-operate more closely in respect of finance and capital expenditure plans and management matters. They already co-operate on the technical and operational levels.

It has been further agreed that the two companies will meet annually with the Minister responsible for telecommunications to discuss and review finance, capital expenditure plans, service provisions and other matters.

The Cable and Wireless delegation to yesterday's conference was headed by Mr. Tom Challew, regional director of Cable and Wireless; and included Sir Fred Phillips, legal advisor;

and Mr. Paul Carrington, general manager.

The Barbados Telephone Company Limited's delegation included Mr. Burton Williams, chief accountant; Mr. Don Hill, chairman; Mr. Charles Evelyn, general manager.

Mr. Eugene Fingall, government's telecommunications engineer, and Mr. Chesterfield Thompson, Permanent Secretary in the Ministry also attended.

Phone Company Situation

Bridgetown ADVOCATE-NEWS in English 18 Dec 82 p 1

[Text]

The Barbados Telephone Company Limited does not plan to apply for an increase in rates next year.

Chairman of the company Mr. Don Hill, said yesterday that there were no plans for a rate application to the Public Utilities Board in 1983 although the company had asked for minor adjustments in installation fees, change of address fees and reconnection fees.

He announced that the company would be spending some Bds $29 million next year.

He said that the company had recorded an 11 per cent growth this year, noting that there were very few countries with companies which could look forward to such growth.

He said that the company had provided 28 000 telephones since 1976 and expected that by 1986 or 1987 it would reach the 100 000 mark.

Mr. Hill said that while this figure would represent one telephone to every 2.5 people, it had to be taken into consideration that a large number of them were used in hotels and other businesses.

In this respect, he noted that of 79 000 houses in Barbados, 44 000 had telephones, which meant that there were still a number without service.

He lamented the fact that much of what has been achieved by the company over the years had gone unnoticed by the public of Barbados.

CSO: 5500/7521

BRIEFS

PHONE COMPANY INTRODUCES OPTICAL FIBERS--On the morning of December 15, 1982, The Barbados Telephone Company Limited embarked upon a new technology--Fibre Optics. The Optical fibre cables installation began with the pulling in of the first lengths in the duct system on Government Hill. This pull covered a distance of 1 kilometre and also created another first in our cable pulling techniques. The installation of a 1 kilometre length of cable in one continuous pull. This scheme is part of the continuing expansion and modernisation programme of the company. On completion, the scheme will encompass a 23.8 kilometre network of optical fibre cable, connecting the Central Offices of Windsor Lodge, Grazettes and St. James. During the installation of this cable, some disruption to normal vehicular traffic may occur for short periods, but every effort will be made to keep these periods to a minimum. The company regrets any likely inconvenience caused to the general public. [Text] [Bridgetown SUNDAY ADVOCATE-NEWS in English 19 Dec 82 p 2]

TELECOMMUNICATIONS STUDY--The Barbados Government has obtained the services of a telecommunications financial expert--Mr. Thomas C. Weaver to provide assistance to the Government for a period of two to three weeks. Mr. Weaver's consultancy was negotiated by the Minister of Information and Culture, Senator Nigel Barrow, when he attended the recent International Telecommunications Conference in Nairobi, Kenya, and is funded by the Technical Assistance Programme of the International Telecommunications Union (ITU). The Ministry of Information and Culture, which is responsible for Communications is currently negotiating the renewal of the licence under which Cable and Wireless operates and which expires on December 31, 1982. At the same time it is necessary to review the arrangements for the sharing of revenues from external telecommunications between Cable and Wireless and the Telephone Company in order that any new revenue-sharing formula should be based on considerations which are fair and reasonable. Mr. Weaver has spent a lifetime in the telecommunications industry. He worked for twenty-five years with the British Post Office, fifteen with the Overseas Telecommunications Commission in Australia, and five years with the UNDP Development Programme for the South Pacific. [Excerpt] [Bridgetown ADVOCATE-NEWS in English 26 Nov 82 p 2]

CSO: 5500/7518

PLANS FOR SATELLITE, SUBSCRIPTION TV DISCUSSED

Spring Inauguration

Hamilton THE ROYAL GAZETTE in English 3 Dec 82 p 1

[Text]

Plans to put Starvision's satellite television subscription channel on the air by next spring were unveiled yesterday by the company's president Mr. Arnold Francis, QC.

He promised a "new and exciting programming package" culled from the BBC and ITV in Britain, the CBC in Canada and United States cable stations. It wasexpected that Starvision will broadcast 24 hours a day.

The plans were revealed at a Press conference in which Mr. Francis announced the public offering of 1,200,000 shares of Bermuda Communications Corporation, better known as Starvision.

"We are endeavouring to raise $1,700,000 so that Starvision can be put on a firm financial footing and be able to broadcast truly first-class programmes," said Mr. Francis.

"Of that amount of $1,700,000 we have been offered a credit facility of $500,000 by a leading UK bank.

"We shall therefore be seeking to raise an additional $1,200,000 by way of public sale of our shares which will be available to both Bermudian and non-Bermudian investors." The company's prospectus will be available within two weeks, he said.

Although Starvision is aiming at a target of $1,700,000 it could operate for almost half that amount. Mr. Francis said that the minimum would be $900,000-$400,000 from the local share offer, plus the money put up by the UK bank.

He added that there were already "certain promises from important backers". But Starvision was "earnest in its desire to see the widest participation" from Bermuda.

"If Bermudians do back Starvision by subscribing to our share offering, as we are confident will be the case, we expect to be on the air by next spring with a new and exciting television programming package the likes of which have never been seen before in this Island."

The programmes Starvision expects to bring in include: news from Mr. Ted Turner's cable station CNN; religious and family shows from CBN which is another US cable station; drama, comedy and documentaries from the BBC; general programmes from the ITV; and sports, news and general affairs from Canada's CBC.

"We are tired of garbage programmes and want some quality programmes," said Mr. Francis.

Starvision would not rely on advertising and would not, therefore, be bound by some of the constraints affecting the existing stations. Nor will Starvision be affiliated to American networks as ZBM and ZFB are currently to CBS and ABC.

Subscription costs to Starvision are expected to be about $15 a month and it is hoped to broadcast for 24 hours a day.

The plans are restricted to the one subscription channel for which Government has granted a licence. Starvision had originally hoped to launch four channels.

Starvision has not yet settled on a site for its future studio and broadcasting antenna. "Where we will operate from is still very much in the negotiating stage," said Mr. Francis.

The Starvision president was flanked throughout the Press conference by company directors Mr. Eugene Saunders, Mr. Lionel Darrell and Mr. John Weston.

Multichannel Possibility

Hamilton THE ROYAL GAZETTE in English 4 Dec 82 pp 1, 2

[Text]

Starvision president Mr. Arnold Francis yesterday revealed that his company may be allowed to broadcast on more than one channel.

Officials from the Ministry of Home Affairs had contacted him yesterday and said that "Government had changed its position in respect of us only getting one channel," said Mr. Francis. "It had no objections to more than one channel."

At a press conference on Thursday Mr. Francis had stated that Government had restricted Starvision to one subscription channel and not the four it wanted.

In the light of his new information Mr. Francis said the Starvision directors would now have to consider whether to start off with one or more channels.

Mr. Francis also sought to clarify Starvision's position over the grant of Government licences.

Starvision has been informed "that one channel is available to us" but the licence will not be granted without satisfying certain conditions, one of which is a solid financial base, he said.

"The last step is the public issue to get financing in hand to get the actual grant of the licence."

Mr. Francis strongly denied claims that Starvision would not be able to keep its promise of satellite television by next spring. It had been argued that it would probably take a considerably longer time to get clearance for international satellite rights.

Mr. Francis said that Starvision intended to make a statement next week refuting that claim.

Starvision announced the public offering of 1,200,000 shares on Thursday. The company is hoping to raise \$1,200,000 locally. It has already been offered a \$500,000 credit facility from a UK bank.

CSO: 5500/7519

CABLE TV SYSTEM PLANS SET FOR INITIAL DESIGN WORK

Hamilton THE ROYAL GAZETTE in English 15 Dec 82 pp 1, 6

[Text]

Engineers are expected to arrive on the Island during the next week to begin preparing a cable network blueprint in preparation for the introduction of Cablevision to home viewers during the summer.

Cablevision president Mr. Gavin Wilson said yesterday the cable-laying experts would "hopefully" arrive before the Christmas holiday and begin mapping out plans for the laying of some 250 miles of cable which will link the long-awaited cable TV system to Bermuda homes.

Mr. Wilson said he expected that by spring everything would be ready to begin linking the first batch of Cablevision viewers to the system which promises an initial 12 channels of 24-hour viewing to each subscriber at a monthly rate of $16.95. Five additional channels showing Walt Disney specials, movies, Home Box Office and others will be offered for an extra fee.

Cablevision will also feed ZBM and ZFB programming through its underground network to viewers' television sets, providing a much clearer picture and eradicating the need for outside aerials or indoor rabbit ears, said Mr. Wilson.

It was also prepared to offer the lease of one channel to competitor Starvision, which last week announced plans to begin broadcasting pay TV on one channel in the spring, he said.

The system — under Government order to be completely installed within three years — will be laid out in 50-mile batches at a rate of 15 miles (or 1,200 homes) per month, he said. He said his conservative prediction was that 30 to 35 percent of TV owners would subscribe to his service.

Cable TV experts Mai Communications of the United States would lay cable outwards in a radius from Cable and Wireless in Devonshire, which has leased property and facilities to the company. Cablevision will pay the American firm 20 percent down before each 50-mile segment is laid, and following Cablevision and Bermuda Government inspection after the segment is completed the remaining 80 percent would be paid.

Mr. Wilson said the company would need financing to the tune of $5½ million — in the form of local and foreign investment plus loans.

The Cablevision boss reiterated claims that the company was the only one on the Island to have secured international rights to pick up satellite signals.

The company would have the potential to televise over 54 separate channels, and would be able to offer one-quarter million data circuits to businesses.

Meanwhile, Mr. Wilson will soon begin looking for someone with a good general administrative background, "preferably Bermudian", to manage the company.

Government offices, schools, senior citizens homes, Police and the Fire Services will be hooked up to the cable network free of charge, said Mr. Wilson.

CSO: 5500/7519

BRIEFS

YASUJ RADIO STATION INAUGURATED--Yasuj, Jan. 2, IRNA--A 40-kilowatt radio station was inaugurated here today. An official of the radio station said to IRNA here that the station would relay the All-Iran Radio (the Voice of the Islamic Republic of Iran, broadcast from Tehran) for eight hours every day. The station also amplifies broadcasts of the All-Iran Radio for its audience in the provinces of Kohkiluyeh Va Boyer Ahmad and parts of the Fars Province. Yasuj is a city about 150 kms north west of Shiraz in Fars Province. [Text] [GF031600 Tehran IRNA in English 1520 GMT 2 Jan 83] On the occasion of the birthday of the glorious prophet, God bless him and all his scion, and the glorious birthday of the sixth glowing star of the skies of sainthood, the Yasuj radio station began operating. According to a report by the Central News Unit, the station operates on medium wave 336.4 meters corresponding to 891 kHz and 262.4 meters corresponding to 1143 kHz and will relay the programs of the Voice of the Islamic Republic of Iran--first program--daily in two time periods. These are 0600-1000 [0230-0630 GMT] and 1300-1700 [0930-1330 GMT] and this will be done on an experimental basis. The power of each transmitter is 10 kw and the antenna is 84 meters long. The entire installation and start up of the station was carried out by the faithful engineers of the Voice and Vision of the Islamic Republic of Iran. The station is located in a compound measuring 50,000 square meters and contains a total of 4 transmitters. [Text] [GF050554 Shiraz Domestic Service in Persian 1500 GMT 4 Jan 83]

CSO: 5500/4715

RURAL TELECOMMUNICATIONS FEASIBILITY STUDY

Kathmandu THE RISING NEPAL in English 14 Dec 82 p 3

[Text] The Japanese feasibility study team on rural telecommunication network project is in the Kingdom of Nepal.

The Japanese expert team headed by Mr. Fukushi Kitachara has already initiated discussions with the General Manager and other officials of the Telecommunication Board.

Working papers regarding extension of rural telecommunication newtwork were exchanged on 23rd September in Kathmandu between His Majesty's Government and the Japan International Cooperation Agency.

The expert team will be doing the feasibility study in different groups for different regions of Nepal.

According to an official concerned of the Telec-Communication Board, the expert team will study the feasibility for expansion of rural telecommunication by using up-to-date communication equipment at some of the important places including those where the country has wireless stations.

The places having the telephone facility at present in the country are Mahendra Nagar, Surkhet, Nepalgunj, Bhairahawa, Hetauda, Birgunj, Kathmandu, Lalitpur, Banepa, Malangawa, Janakpur, Rajbiraj, Biratnagar, Bhadrapur and Dharan. Dhankuta will also be having the facility from 29th December.

The places in the country having microwave links include Surkhet, Nepalgunj, Bhairahawa, Palpa (V.H.F.). Butwal, Bharatpur, Birgunj, Malangawa, Rajbiraj, Janakpur, Biratnagar, Dharan, Bhadrapur and Siraha.

The master plan for telecommunication development will have a projection of 15 years.

Once the master plan is implemented, direct dialing will be possible internally and externally through earth satellite stations, the official concerned said. (RSS)

CSO: 5500/4320

BRIEFS

HIGH POWERED SSB SYSTEM FOR RNAC--A new high power SSB (single side ban) radio 'antenna' has been made available to RNAC to improve 'ground to air communiction', domestically and internationally. The SSB system will enable the airline to get timely information on weather condition and position of aircraft at any remote and distant station. The "antenna" is rotable and can be turned to different directions to obtain maximum response. The new system provides 400 watts transmission power and involves a financial outlay of 320 thousand rupees. The equipment has been made available to RNAC through the Lufthansa consultancy program, under the technical aid fund of the Federal Republic of Germany. Construction and erection of the system was completed with the help of RNAC personnel and the royal flight. [Kathmandu THE RISING NEPAL in English 14 Dec 82 p 6]

CSO: 5500/4320

BRIEFS

SKARDU RADIO TRANSMITTER OPERATIONAL--A 10-kwt medium wave radio transmitter became operational as of 23 November. The transmitter will broadcast from 0945 to 1600 GMT every day. It will carry programs for a little more than 6 hours. The programs will include 2 hours and 40 minutes of programs in Balti language. The Khardu radio will be heard within a radius of 80 km from Skardu. [Text] [GF231312 Peshawar Domestic Service in Pashto 1330 GMT 23 Nov 82]

CSO: 5500/4324

LBC DIRECTOR SAYS ELBC TO BE HEARD NATIONWIDE BY END JANUARY 1983

Monrovia DAILY OBSERVER in English 17 Dec 82 p 12

[Article by Abdullah Dukuly]

[Text]

The national radio station ELBC is expected to be heard throughout the country by the end of January, 1983. This was disclosed yesterday by the Director-General of the Liberia Broadcasting Corporation, Mr. Alhaji G.V. Kromah, at the first commencement exercises of the Fallah Varney Memorial Institute at the E.J. Roye Building in Monrovia.

Mr. Kromah said various technical and other preparations to accomplish this goal were nearing completion.

He also said LBS management had launched a multi-million dollar national and international fund drive to expand television services throughout the country within the next two years.

He observed with happiness that other essential aspects of LBS seem to be moving along "the anticipated direction."

Mr. Kromah said the exercises were geared towards developing a communication system at LBS in its commitment to achieve the needs and aspirations of the Liberian people.

Communication in every sector of life is a vital instrument in national development, he noted.

Speaking on the theme "Communications: Its Obligation in a Changing Society", Mr. Kromah said: "The growing dimensions of communications technology and the development anxieties of nations, particularly developing countries, have made the role of communication in the development process an increasing field of exploration".

"It is a social process that attempts to answer economic, cultural, religious, constitutional and other questions," he asserted.

Noting that some areas were often left out in national development policy while others were considered. Mr. Kromah said, "sometime legitimacy of these decisions are not consistent".

Regret

He regretted that it was only few years ago that priority was given to broadcasting, telecommunication and postal services. He emphasized that communication technology was one of the infractures that must be

developed.

The Director-General said communication did not receive "serious" attention in the past and cited Betu, Sasstown Territory, as one example of the many places in the contry where ELBC cannot be heard.

"If you anticipated hearing some important development message, you probably will never get that message because our national radio station would not guarantee continuous transmission to cover that distance.

"Pick up the telephone to call Paynesville, and you would probably not get through. Send your letter to Voinjama, and it would probably arrive three weeks later," Mr. Kromah stated.

He commended the Post and Telecommunications Minister for launching a door-to-door mail service and making efforts to improve

CSO: 5500/77

MAPUTO COASTAL TELECOMMUNICATIONS NETWORK UNDER WAY

Maputo NOTICIAS in Portuguese 29 Nov 82 p 8

/Article by Benjamin Faduco/

/Excerpts/ The first station in the Mozambican merchant marine coastal telecommunications system is being installed in Maputo and should go into operation in the first quarter of next year, we learned from the executive director of the project. Radio equipment is already being installed in some Mozambican ships.

The Maputo coastal station now under construction is part of a project to establish a national maritime telecommunications system, under the direction of the specialized Italian firm TVR.

Similar stations will later be installed in the cities of Beira and Nacala, and together they will serve all ships and other vessels that travel the Mozambican coast.

The maritime telecommunications system is suitably equipped to transmit weather bulletins and sailing advisories, specifically to coastal vessels, long-range ships and fishing boats navigating the Mozambique channel.

Safety for Lives at Sea

One of the basic functions of the future maritime telecommunications system is to safeguard human lives at sea, a function which is now limited because no such communications system exists along the coast and because the local radio stations are inadequate.

The future communications system will insure continuous land-sea communication and vice versa, by telephone and telegraph (Morse code) for the entire length of the Mozambique channel.

At the same time, radio equipment is now being installed in some of the nation's ships and will begin to function when the first coastal station goes into commercial operation.

The coastal ships "Pemba" and "Polana" have already been fully outfitted, while about half the radio equipment has been installed in the "Muanza."

Project Status

Regarding the necessary equipment for the maritime communications project, we learned that it has all been acquired for the initiation of construction of the Beira and Nacala stations.

In Maputo, where construction is in an advanced stage, the first antennae are already being mounted. All the necessary equipment is already in the country.

The equipment for the Beira and Nacala stations has already reached the respective sites, except for a small part of the Nacala coastal station. It is expected to arrive before the end of the year.

The civil construction works at the Maputo station are under the direct supervision of the National Directorate of Sea and River Transport [DNTMF]. Construction of the Beira and Nacala stations will be undertaken by specialized firms contracted for the purpose.

Housing for Workers

A residential area will be constructed near each coastal station to house the workers who will operate and maintain the three regional maritime communications stations.

Training for Mozambicans

To insure operation and maintenance of the entire system, the Italian firm TVR will provide professional training for Mozambican technicians.

The training program in maritime telecommunications (operation and maintenance) is included in the provisions of the agreement signed between the TVR and the DNTMF.

The training of Mozambican cadres will be comprehensive, having begun with the construction phase and extending to the operation of the entire system.

6362
CSO: 5500/62

TELEVISION TO BE OPERATIONAL SOON IN GAYA

Niamey LE SAHEL in French 15 Nov 82 pp 2, 3

[Article: "The Director General of ORTN [Niger Radio and Television Broadcasting Office] to Our Colleague From La Voix du Sahel: Television Will Soon Be Operational in Gaya"]

[Excerpts] Thursday 11 November the Cabinet met, chaired by the president of the Supreme Military Council and chief of state, His Excellency Col Seyni Kountche. It considered and adopted a certain number of draft texts among which was the draft ordinance authorizing the chief of state to raise two loans from the Central Fund for Economic Cooperation (CCCE) for an overall total of F Fr 10 million, which is Fr CFA 500 million.

These loans are intended for, on the one hand, financing the project for bringing television to the city of Gaya by the constructuion of a television antenna tower and the installation of two medium-wave and frequency-modulation transmitters, and, on the other hand, accomplishing studies preparatory to continuing the joint telecommunications and television program launched in 1979.

Mr Moctar Diallo, the director general of ORTN, was happy to give us more details regarding the nature of those projects.

He said, "The project for bringing television to the city of Gaya is materializing specifically to fill a certain gap that we have in the area covered by radio and television broadcasting in that region. Already in 1977 we made an effort at providing radio broadcasting by setting up a small 100-watt transistorized relay transmitter on the Gaya hilltop, the objective having been to relay programming on Channel One of La Voix Du Sahel [The Voice of the Sahel]. That installation is going to be finished shortly.

With regard to the television project per se we are talking about resuming an effort already underway. A 10-kilowatt television transmitter does in fact exist in Dosso. A range measurer enabled us to estimate the transmitter's transmission pattern. Unfortunately its range capacity does not allow the Gaya area to be covered. In order for that area to be covered additional efforts had to be examined.

In further study we observed that coverage was possible from Bella, a village located about 60 km from Gaya. But in connection with the PANAFTEL [Pan-African Telecommunications Network] Project a tower was recently set up in Kote-Kote, a village located about 23 km from Gaya. We have confirmed that it would be possible on that tower to pick up the Dosso tower and also be in range to broadcast to Gaya. The project we are talking about consists of picking up the 10-kilowatt Dosso tower's transmission at Kote-Kote and transmitting that same signal to our Gaya receiver center situated on the hilltop. At the Gaya end it is a matter of picking up the signal from the small Kote-Kote transmitter. Then we demodulate the signal [that is to say, we extract the signal that can be used for television] and we rebroadcast it on a larger transmitter with a one-kilowatt capacity to cover the whole of the Gaya region.

The following should be noted. The Dosso transmitter has a 10-kilowatt capacity and a 100-km range which does not simply mean that it can cover up to a 100-km radius around Dosso if everything is working all right, because there are many factors that enter into transmission-namely:
-the frequency of the transmitter, since the range is different according to whether we are operating in band three or band four;
- the height of the tower on which the antenna is set up: the tower is just the support structure for the antenna--a 100 to 200 meter-high mass of iron--and the higher the tower the greater the range; and,
-geographical contours matter a great deal in transmission, as do atmospheric conditions.

In Niger's case, and with this 10-kilowatt transmitter with its 100-km range and 200 meter-high antenna, we do not expect a problem to emerge. Because of those conditions we have been able to reach Kote-Kote from Dosso, located about 110 km away. To cover the distance from Kote-Kote to Gaya we have considered it a good idea to use a less costly system than radiowave called/televisual retransmission/[in boldface] involving a small 1-watt capacity transmitter. The special thing about this equipment is that it will be powered by solar energy. From 1972--the time when we began using this system--to the present, ORTN has acquired nearly 1,000 pieces of solar equipment. It should also be pointed out that our 1-kilowatt television transmitter will have a range of about 40 km, taking into account the 80-meter height of the tower (not to mention that the transmitter is set up on a hill the elevation of which is 500 meters).

With respect to radio, a 100-watt FM transmitter will be installed. Orders will be placed shortly.

For the time being the Gaya area receives short-wave radio broadcasts with, of course, some atmospheric disturbances. That situation is explained by how waves are transmitted in the atmosphere and how they are received. The system in short-wave radio is not quite the same as in television. Transmitters shoot their broadcasting at the sky and, according to the angle at which the transmissions are shot, the reflecting layer of the ionosphere sends the waves back to the earth. At the first point where it bounces back one is usually guaranteed good reception. But it often happens that a distant location receives a second bounce because there is a certain law of science with respect to a radioelectric zone that reflects from the earth. So at that point there would

be a second reflection from the earth to the sky, and then a third from the sky to the earth. Thus according to the position of the zone the wave quality deteriorates more and more at either the first or the second reflection. It should be observed that all points located between 150 and 700 km from Niamey are generally included within the second bounce of our transmission. That also means that they do not get good reception of our transmissions as a rule. By installing a medium-wave relay transmitter the transmittion situation becomes more favorable from the standpoint of quality.

Our television receivers are high-quality and their cost varies between 800,000 and 1,000,000 francs, not to mention the fact that they are equipped with antennas that are between 50 and 200 meters high depending on whether our transmitter is operating on nighttime or daytime frequency.

To get back to the Gaya television project, we have to say that we are lacking in solar power utilization. Moreover, the city of Gaya electrification expansion project is currently stopped. We would hope that along with that project our television installation can likewise be completed.

The joint telecommunication and television extension program is a project that was started up in 1979. When the issue arose of reorienting the educational television system and starting a national television systems, we conceived a system that would not be very costly for the Nigerien Government and would enable us to work out a joint program with OPT [Postal and Telecommunications Office], considering the OPT and ORTN have a common telecommunications trunkline.

Our project is a joint one mainly in the transmission area. Thus, on the Niamey-Zinder radiowave link we have one channel for the PTT [Posts and Telecommunications] transmission system and the other for Radio and Television Broadcasting. The pursuit of financing in this area has been made a joint effort, a joint credit arrangement making that necessary.

In the technical area it would not serve any useful purpose to simultaneously develop different systems. That is why we must colloborate closely in order to make the most progress on our transmission systems, taking into account OPT's experience in the area. It goes without saying that problems of training skilled personnel are presented at all levels. But together we shall be able to resolve them, step by step. The rest is only a matter of time and, most of all, resources.

On our side we are planning for all the radio and television production and broadcasting equipment. On their side the PTT has 1,000 to 1,200 km of radio linkage to maintain not to mention the training of skilled personnel in special telecommunications. In addition, the OPT provides the administrative and technical management for the transmission system. This does not prevent ORTN from training its own specialists in the various fields if only in a more restricted framework.

The joint project in question is spaced out in several stages. The project actually started up when it was a matter of extending the Dosso system to the rest of the country. The phase of extending the Dosso-Zinder radio link via Konni and Maradi constituted the first stage. In the production area, ORTN changed its equipment from black and white to color.

The second stage of the project was with respect to the matter of reaching Ditta and Agadez-Arlit. Studies were done and actual work is well on the way to being completed.

For the next, and therefore the third, stage, we must carry out studies, taking into account the needs of both ORTN and OPT. That is where the financing we are talking about comes in. Here for the PTT what must be done is the expansion of the telephone network in urban centers, training of additional skilled personnel, et cetera.

There are three sources of financing: the PTT/ORTN program is being financed by a loan from the Central Fund for Economic Cooperation, COFACE [French Insurance Company for Foreign Trade] credits, and a FAC [Aid and Cooperation Fund] grant. The overall cost of work on the project will be on the order of more than Fr CFA 15 billion if one makes allowances for interruptions in this estimate.

Finally, with regard to the project for bringing television and radio broadcasting to Gaya, ORTN has at its disposal Fr CFA 100 million on account of the projected 500 million.

9631
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ABC BACK ON AIR FOLLOWING DISRUPTION BY 'SABOTEURS'

Enugu DAILY STAR In English 29 Dec 82 p 1

[Text] The Anambra State Broadcasting Corporation, ABC I, Enugu, resumed partial transmission yesterday after a four-day disruption caused by "political saboteurs."

According to the Management of the ABC, the transmission is on FM band frequency in 90.7 mega hertz which can be received in Enugu area, including parts of Abakaliki and Nsukka senatorial zones.

The management further said that the transmission would continue on that frequency until further notice.

It explained the ABC's booster station, ABC II at Onitsha, was on with normal transmissions from 6 am to 6 pm daily which could be picked by its audience in Awka, Onitsha and Enugu senatorial zones on 1062 kilo hertz, 263 metres in the medium wave band.

According to a Daily Star survey, a majority cross section of the people of the state suspect the National Party of Nigeria (NPN) for this nefarious act more so when some threats to that effect had been reported in the media.

Most of the people polled also blamed the State Command of the Nigeria Police Force of neglecting one of its primary assignments--protection of lives and property--in the state when such threats had been made public earlier.

It would be recalled that the Anambra Broadcasting Corporation (ABC) transmitting station at the 9th Mile Corner near Enugu, was burnt on Saturday.

Two officials of the corporation told the News Agency of Nigeria (NAN) that the fire which started at about 8.30 am was caused by two armed men who arrived at the transmitting station on a motorcycle.

The officials, Messrs I.N. Anikwe, and L.E. Awahalu, said that the men held members of staff of the station at gunpoint before setting the station on fire.

They said that they had noticed a smoke at the diesel room earlier in the morning and informed the chief engineer at the Enugu main office and the security men.

The officials said that a formal report had been made to the state governor and the police while armed policemen are guarding the premises.

CSO: 5500/84

BRIEFS

LAGOS IMPORTANT 'PANA' CENTER--Lagos, 19 Jan (NAN)--The director general of the Pan-African News Agency (PANA), Mr. Cheick Ousmane Diallo, said in Lagos today that the Nigerian capital would play an important role in the operations of the agency when it begins functioning later this year. Mr Diallo told the News Agency of Nigeria (NAN) that the Lagos center would receive 8,000 words a day from the 16 member-states in West Africa and transmit them to PANA headquarters in Dakar, Senegal. This represents about one-third of the total number of words which the central headquarters would receive every day for distribution Mr Diallo said. He said that PANA would send news to other parts of the world with a view to correcting the distorted picture of Africa created by the foreign media. [passage omitted] Mr Diallo, who arrived in Lagos yesterday for a three-day visit is discussing, among other issues, the PANA office and staff in Lagos. [Excerpts] [AB191544 Lagos NAN in English 1520 GMT 19 Jan 83]

CSO: 5500/86

BRIEFS

INDIAN RADIO SERVICE--The SABC is beginning a new radio service, Radio Lotus, for Indian listeners in Natal. Test transmissions began yesterday and the full service will be introduced on Saturday. It will broadcast in English from 4 pm to 9.30 pm from Mondays to Fridays, with longer broadcasting hours over the weekend.--Sapa. [Text] [Johannesburg THE CITIZEN in English 4 Jan 83 p 10]

CSO: 5500/80

BRIEFS

NEW TELECOMMUNICATIONS FIRM--A new telecommunications company has just opened in Kampala to cater for the national reconstruction needs and growing demand. Its Managing Director, Mr John Karuma, says Watts-Interntional Ltd will mainly deal in the latest telecommunication equipment on the market. One of its specialised areas will be the latest and modern Thomson CSF telephone exchange, he said, for which the company is the sole agent. The Thomson telephone exchange is a powerful system with expandable and automatic call-back facilities. Other built-in facilities make telephone use both a leisure and a more dependable method of communication. More areas of operation will include refrigeration, large-scale air conditioning systems and modern m dical equipment like x-rays etc. However, Karuma says for now the company will only concentrate on servicing and repair of the x-rays and air conditioning systems already in the country. For the repair work, Karuma says the company has good access to spare parts for most of the equipment. "We have well-qualified staff, trained both here and abroad," the managing director says. And there are specialists in particular machines who are trained by the manufacturers. Watts-International Ltd is situated at Kitgum House, Station Road, Kampala. Tel 42411 and 42436. [James G. Karasanyi] [Text] [Kampala UGANDA TIMES in English 9 Dec 82 p 3]

CSO: 5500/85

NEW TECHNIQUE FOR PRECISION DME OF MICROWAVE LANDING SYSTEM

Milan ALTA FREQUENZA in English Sep-Oct 82 pp 242-256

[Article by Franco Chiarini, Mauro Gori, Francesco Vatalaro, of Laboratorio Central Industrie Face Standard-Pomezia, and Giorgio Corazza, Gabriele Falciasecca, of Istituto di Elettronica, Universita di Bologna Viale Risorgimento, 2-40136 Bologna: "A New Technique for the Precision DME of Microwave Landing System"]

[Text]

Abstract. The new electronic landing system now being developed, denoted as Microwave Landing System (MLS), will adopt the Distance Measuring Equipment (DME) as a range subsystem. Therefore efforts have been made in many countries to develop a Precision DME, which must have a performance adequate to the approach and landing needs and must be fully interoperable with the conventional navigation equipment.

This paper describes an original technique, the Double Pulse Shaping (DPS), for DME use, which allows us to independently optimize the pulse shape in transmission and the waveform at the input of the decision circuit, thus assuring the interoperability, the needed accuracy and the required coverage.

Complete systems definition with the aid of computer simulations and lab tests has been done taking into account all the causes of measurement errors (mainly multipath and noise).

The hardware realizations carried out during the research (DPS filters, time of arrival detection network, r.f. and i.f. sections, etc) eventually validate the DPS principle, and demonstrate the uncritical feasibility of DPS-based systems.

An Italian proposal has been presented to the appropriate ICAO bodies on the basis of this work.

1. INTRODUCTION

In the field of radio-aids to air navigation some important technological and operational innovations are expected in the near future in order to meet the increasing needs of civil and military aviation. In particular, a new electronic landing system denoted MLS (Microwave Landing System) [1] is now being developed, which will eventually replace the present ILS (Instrument Landing System).

The MLS is an air-derived data system which operates at microwave frequencies to provide separate information, that is, the angular position of the aircraft (azimuth and elevation) and the distance from a known ground station (range). For the angular subsystem, the TRSB (Time Reference Scanning Beam) technique [2] has been chosen by the ICAO (International Civil Aviation Organisation) community. Owing to the strong extension of operational requirements, this technique is completely different from the one used for the ILS.

For the range measuring system, discussion is still in progress in the ICAO working groups and a decision is expected shortly. At present a radio-aid does exist, the DME (Distance Measuring Equipment), specified in an ICAO publication, Annex 10 [3], operating in the *L*-band capable of performing this service, both in navigation, and in landing, coupled with the ILS. For MLS applications no different functional requirements are necessary for the range measuring subsystem, but only a great improvement in accuracy is required. As a matter of fact a new independent system has not been considered economically sound but on the contrary, research has been planned in order

to combine all the functions in a single apparatus. To do this the equipment must be fully interoperable:

– a new on-board apparatus must be capable of utilizing a conventional ground station with accuracy not less than that presently required;

– a conventional on-board apparatus must be capable of utilizing a new ground station with accuracy not less than that presently required.

Moreover further constraints for the interoperability are the specifications of Annex 10 [3].

Research in order to find suitable techniques for the new DME, denoted by DME-P (where P stands for Precision), has been planned in many countries. In Italy this became one of the objectives for the Project on Navigation Aids and Air Traffic Control sponsored by the Consiglio Nazionale delle Ricerche (CNR) [4]. This research has been carried out by the Industrie Face Standard in conjunction with the Fondazione Ugo Bordoni and this paper deals with one of the most important results obtained.

In the following a technique, denoted DPS (Double Pulse Shaping), is illustrated and the advantages of its application to the DME-P are described. This technique is based on analog processing of the signal. The objective is to render the output waveform of the receiving filter practically independent from the transmitted one and thus to optimize the r.f. section of the transmitter and the detection section of the receiver separately. The application of the DPS technique led to the definition of the two systems with different accuracy requirements, which are intended for MLS operations, assuring the interoperability in the strictest sense. Moreover, any other technique capable of improving the accuracy can be advantageously added.

Theoretical investigations were carried out simultaneously with experimental work. In the Central Laboratory of the Industrie FACE Standard at Pomezia (LCF) an experimental set up was developed which fully validates the practical feasibility of the circuits involved in the system. Measurements are in good agreement with the expected improvement of accuracy and the interoperability has been demonstrated. A complete prototype is in development in order to also test the system with the necessary flight tests.

On the basis of the results of the work here described an Italian proposal has been presented to the appropriate ICAO bodies [5].

At present this proposal, having successfully come through the preliminary discussions, is considered by the technical working groups of the ICAO to be competitive with the other proposals presented by the Federal Republic of Germany, France, Great Britain, Japan and the U.S.A.

2. OPERATIONAL REQUIREMENTS AND CONSTRAINTS FOR THE DME-P SYSTEM

The operating principles of the present DME [6] are the following: the on board equipment (interrogator) transmits a pair of pulses; the ground equipment (transponder) receives this signal and replies after a fixed known delay (main delay) with a replica of the pair of pulses received. The receiving section of the interrogator is able to evaluate the distance between the aircraft and the transponder site by means of the measurement of the propagation delay.

Let us now examine a single link (air to ground or viceversa); the operating principle is schematically illustrated in fig. 1. The output of the pulse generator is a pair of pulses, each having the shape $g(t)$ in the time domain and $G(f)$ in the spectral domain. Before amplitude modulation the signal is filtered by the pulse shaper circuit in order to obtain, in trasmission, a signal $v_T(t)$ satisfying the ICAO specifications. To do this the pulse shaper has a transfer function $A(f)$ of low-pass type.

Assuming in the following that the two pulses are without differences, with reference to a single one, the expression of $v_T(t)$ reads:

$$v_T(t) = V_0 x(t) \cos \omega_0 t \tag{1}$$

where ω_0 is the angular frequency of the carrier, $x(t)$ is the inverse Fourier transform of $X(f) = A(f)\,G(f)$ and, without loss of generality, max $|x(t)|$ is assumed to be equal to one. Moreover, in the following, t_0 denotes the time of transmission of the signal from the interrogator (reference time) assumed to be the half-peak amplitude point, that is: $x(t_0) = 0.5$.

The ICAO time-domain specifications can be expressed as follows [3]:

$$\begin{aligned} &d = 3.5 \pm 0.5\,\mu s \\ &t_r \leqslant 3\mu s \ \ (\text{tipically } 2.5\mu s) \\ &t_f \leqslant 3\mu s \ \ (\text{tipically } 2.5\mu s) \end{aligned} \tag{2}$$

where, t_r, t_f are, respectively, the times from 10% to 90% of the leading edge or the trailing edge, and d is the half amplitude duration. This applies equally to the on board or ground equipment.

On the contrary the frequency domain ICAO specifications (spectral purity) are different in the case of transponder or interrogator. In order to clarify this point, let us define:

$$\begin{aligned} W_0 &= \frac{G_T V_0^2}{2d} \int_{-0.25}^{0.25} |X(f)|^2 \, df, \\ W_1 &= \frac{G_T V_0^2}{2d} \int_{0.55}^{1.05} |X(f)|^2 \, df, \\ W_2 &= \frac{G_T V_0^2}{2d} \int_{1.75}^{2.25} |X(f)|^2 \, df, \end{aligned} \tag{3}$$

were G_T denotes the transmitting antenna gain and f is expressed in MHz.

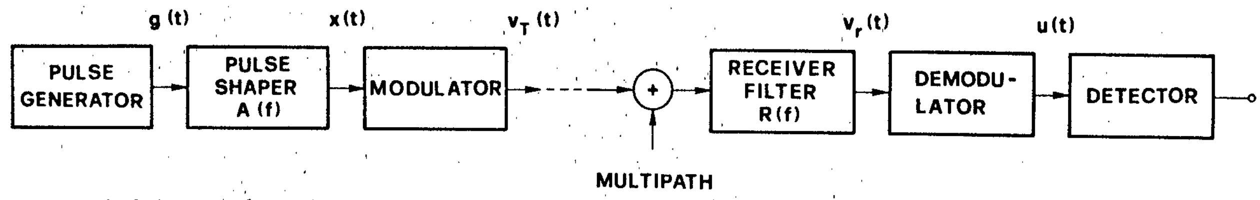

Fig. 1 – Block diagram of the DME system.

The quantities in (3) represent radiated powers during the pulse in spectral windows of 0.5 MHz with off-set of 0 MHz, 0.8 MHz, 2 MHz from the carrier, respectively.

The constraints for the transponder are:

$$(4) \qquad W_1 \leqslant 200 \text{ mW}, \quad W_2 \leqslant 2 \text{ mW};$$

for the interrogator:

$$(5) \qquad \left(\frac{W_1}{W_0}\right) dB \leqslant -23\, dB \qquad \left(\frac{W_2}{W_0}\right) dB \leqslant -38\, dB.$$

For ideal propagation the signal is only attenuated and delayed. Let us denote the attenuation A_0 and the delay τ_0. If $R(f)$ represents the equivalent low pass transfer function of the receiving filter, it is possible to compute its output by means of:

$$(6) \qquad Y(f) = X(f)\, R(f) \qquad y(t) = \mathscr{F}^{-1}\{Y(f)\},$$

where $y(t)$, the inverse Fourier transform of $Y(f)$, represents the envelope of a single received pulse in ideal conditions. Without loss of generality $y(t)$ can be assumed to be real.

As a result of the previous statements the received signal is:

$$(7) \qquad v_R(t) = \frac{V_0}{A_0}\, y(t-\tau_0) \cos(\omega_0 t + \varphi_0)$$

with φ_0 denoting the phase of the received carrier. If $v_R(t)$ is fed as the input to an ideal envelope detector, the output is:

$$(8) \qquad u(t) = \frac{V_0}{A_0}\, y(t-\tau_0)$$

As in the transmission, in the receiver the time of arrival (TOA) of the pulse is estimated with reference to the half--peak amplitude. This operation is physically performed in a strict sense by the present estimation circuit of the DME equipment, using the second pulse of the pair. For ideal propagation the value of the TOA for the air to ground link is $t_0 + \tau_0$. Before transmitting the pulses of the reply, the transponder introduces the main delay $\tau_p = 50\mu s$; the reference time for the reply in transmission is $t_0 + \tau_0 + \tau_p$, with a corresponding TOA at the interrogator receiver of the value $t_0 + 2\tau_0 + \tau_p$ (1). Knowing the reference time t_0 and the main delay τ_p, on board it is possible to estimate τ_0 and, consequently, the distance between the subsystems, i.e. the range r.

In practice, $u(t)$ is subjected to distortion for various reasons and the TOA estimation in both the links is affected by errors. The estimation of range, $\hat{r}$, is then expressed by:

$$(9) \qquad \hat{r} = (2\tau_0 + \Delta\tau)\, c/2,$$

where $\Delta\tau$ represents the error in time and c is the light velocity in free space. Correspondently, the range error is:

$$(10) \qquad \Delta r = \Delta\tau \cdot c/2$$

On board the interrogations are repeated at an average rate of 30 Hz. The low duty-cycle enables many interrogators to use the same ground station simultaneously. Multiple access is obtained by means of a random modulation of the interrogation rate [6] which allows an aircraft to distinguish its own replies.

At present the measurement ripple is implicitly filtered by the display of the equipment. It is common opinion that in the new DME interrogator a digital filter will perform this function with controlled performance and with the possibility of interpolating missed measurements and computing the speed of approach (range rate).

As far as the channelling plan is concerned, a frequency division (spacing 1 MHz) is used, in conjunction with a time code division (two different spacings between the pulses of a pair, denoted X and Y codes). This concept will be maintained with an increased number of codes.

The value of Δr is affected by many causes: multipath, thermal noise, interference, errors of electronics. The definition of the accuracy of the DME-P concerning Δr has been the subject of international discussion which is still in progress. Agreement was reached about these points. The procedure for computing the error is the following: assuming Δr as a zero mean random variable dependent on many causes, the variance $E(\Delta r^2)$ of the error due to a single cause is computed in conditions where other causes are negligible; to compute the overall $E(\Delta r^2)$ the rule of variance composition for independent variables is assumed to be valid; the reference error e is defined as that value not exceeded for 95% of time: if Δr follows a gaussian p.d.f. it follows that

(1) More rigorously, the delays of the two links, air-to-ground and viceversa, are not identical because of the aircraft motion. However, this effect is absolutely negligible owing to the very low ratio between the actual speed of the aircraft and the speed of the light.

$$(11) \qquad e = 2\sqrt{E(\Delta r^2)}$$

The constraints for the accuracy are then specified with reference to the effects and not to the causes. To clarify this point, let us introduce the power density spectrum of the random variable Δr, function of the time. As shown in fig. 2 it is possible to divide the abscissa axis into three regions slightly overlapping, by examining the interaction of the signal

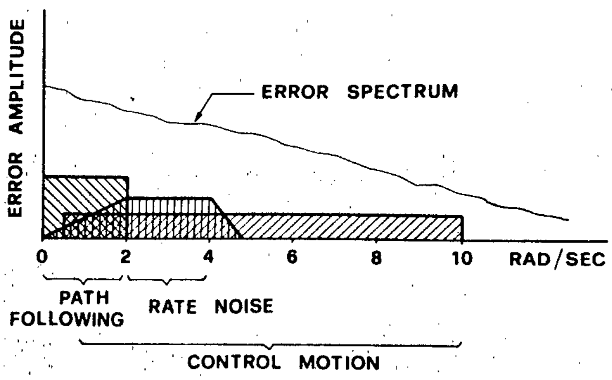

Fig. 2 – Spectrum of the different components of the DME error.

with the aircraft in terms which can be directly related to the aircraft guidance and flight control system responses. The lower region is occupied by the Path Following Error (PFE): the PFE consists of low frequency signal perturbations which are within the aircraft guidance loop bandwidth and which can consequently cause the aircraft to deviate from its desired course (region between 0 and 2 radians/s of fig. 2). Error perturbations which do not affect the aircraft's position, but rather its attitude, are confined to the region between 0.5 and 10 radians/s. This is an annoying noise, called Control Motion Noise (CMN) which has a negative impact on pilot and passenger acceptance criteria. Above 10 radians/s the aircraft autopilot is not sensitive at all.

The methodology for specifying the errors in terms of PFE and CMN was adopted for the angle components of MLS and is now used for the DME-P.

In order to cope with all the new requirements, the MLS system must allow not only for applications CTOL (Conventional Take Off and Landing), but also for STOL (Short Take Off and Landing) and VTOL (Vertical Take Off and Landing) applications. It was then generally agreed to define systems with different accuracy requirements for different aircrafts (at least two systems).

On the contrary, the definition of the permitted values for the PFE and CMN in the key-points of the landing is still open to discussion. This decision is strictly correlated with the choice of the most suitable tecnique for the DME-P. At the present time it seems a reasonable assumption that the more stringent specification will be at the Reference Datum [1] and that the system should be determined on that basis. In this work these values were assumed:

$$\text{PFE} \leqslant 30 \text{ m}, \qquad \text{CMN} \leqslant 12 \text{ m}$$

for CTOL and STOL applications,

$$\text{PFE} \leqslant 12 \text{ m}, \qquad \text{CMN} \leqslant 2 \text{ m}$$

for VTOL applications. The experimental way of verifying the errors, according to the 95% rule, was specified in this way: for every signal record 40 *s* long, the value is not exceded for more than 2 *s* (5% of the record duration). In order to distinguish between PFE and CMN, proper filters are defined.

This methodology leaves the study of the correlation between cause and effects to the designer. As a result of this work the multipath was identified as the main source of PFE [7] and simultaneously the limiting factor for the accuracy of the actual DME. Nevertheless, no agreement has yet been reached as far as the quantitative specification of the multipath sources is concerned. For system design purposes it is necessary to refer to a simple but conservative model for the multipath; for validation "a posteriori" a computer simulation is claimed to be more appropriate. In the following section the choice adopted in this work will be illustrated together with the technique we propose to reduce the influence of the multipath on the range errors.

3. PRINCIPLE OF OPERATION OF THE DPS TECHNIQUE

In this section a method, called the Double Pulse Shaping (DPS) technique, capable of reducing the multipath effects, will be introduced. Let us first illustrate why this technique looks favourable for DME applications. With the actual detection network of TOA the single link multipath error is strictly related to the rise time of the pulse. To reduce its value the use of the digital filtering introduced in the previous section was first suggested, but in this case the advantage is negligible if the errors among successive interrogations are strictly correlated. It was demonstrated [7] that some actual landing scenarios exist where the multipath effect is constant for a very long time during the landing. In this case it is possible to improve the efficiency of the data processing with randomizing techniques. One possibility is the use of a space diversity antenna system as investigated in [8], but the price of this solution suggests using it only when the site conditions strongly exceed the average and other cheaper techniques are not completely successful. Therefore, it may be concluded that digital filter alone, while useful, cannot solve the problem.

As a matter of fact, some proposals based on the modification of the detection circuit and the transmitted waveform were advanced. These proposals [7], [9], [10], [11], [12], similar in principle, basically adopt the following techniques:

a) the TOA is estimated on the first pulse of the pair, less affected by multipath (the second pulse is also affected by the

(1) Reference Datum: A point on the minimum glide path at a specified height above the threshold (ICAO definition).

multipath due to the first one);

b) the TOA is estimated by anticipating the threshold crosspoint in order to operate on a leading edge which is less distorted by multipath;

c) the detection of TOA does not include the estimation of a peak value where the multipath in strongly active;

d) in order to make technique b) more effective and feasible, the present transmitted waveform, of gaussian shape, is strongly modified.

The point d) is a basic one for the proposals mentioned, because the present pulse rise time is too long and the derivative in the first region of the leading edge is too low. The suggested waveforms exibit a sharp rising of the leading edge at low values, with a rise-time of about 1 μs and a shape of cosine type. As a result, the receiver bandwidth must be wider than the present 1 MHz channels, and about 3 MHz of bandwidth are proposed in order to have tolerable distortion. This feature is in fact possible thanks to the low duty-cycle. A proper circuit (see for example the Ferris discriminator [13]) enables the wide-band receiver to operate by estimating whether the main frequency content of the signal is in the desired channel.

The disadvantages of this kind of solution are the following:

– the shape of $x(t)$ is very different from the one presently used with increasing difficulties for interoperability;

– the power spectral density is spread out: according to eq. (4) the permitted power in transmission is lower causing problems of field strenght at the limits of the coverage;

– it is practically impossible to use the same pulse waveform in transmission for CTOL and VTOL applications.

These disadvantages are eliminated by means of the DPS technique. In order to illustrate its operating principles, let us examine the block diagram in fig. 3, where the equivalent base-band network of a DME system is illustrated. The pulse shaper necessary to obtain a waveform $x_1(t)$ with a sharp leading edge can be assumed to consist of a cascade of two networks. This means that in theory the modified waveform can be realized by adding to a conventional pulse shaper a linear network with transfer function:

$$A_1(f) = \frac{X_1(f)}{X(f)} \tag{12}$$

where $X_1(f)$, $X(f)$ are the Fourier transforms of the signals involved. In this case $x(t)$ is only slightly modified from the present waveform, but the high pass network of (12) is not generally feasible in practice. On the other hand, the bandwidth of the receiving filter $Q(f)$ must be wide enough not to introduce distortion on $x_1(t)$. Assuming that linearity exists in the whole transmission channel the desired waveform $y(t)$ can be equivalently obtained by putting $A_1(f)$ in the receiver, as shown in fig. 4. In practice the number of networks is not increased and physical feasiblity must now be assured for the transfer function:

$$R(f) = A_1(f)\,Q(f) \tag{13}$$

In this case the transmitted waveform $x(t)$, practically unmodified, guarantees the interoperability, while the waveform $y(t)$, obtained before the detection, can be designed to reduce the multipath errors.

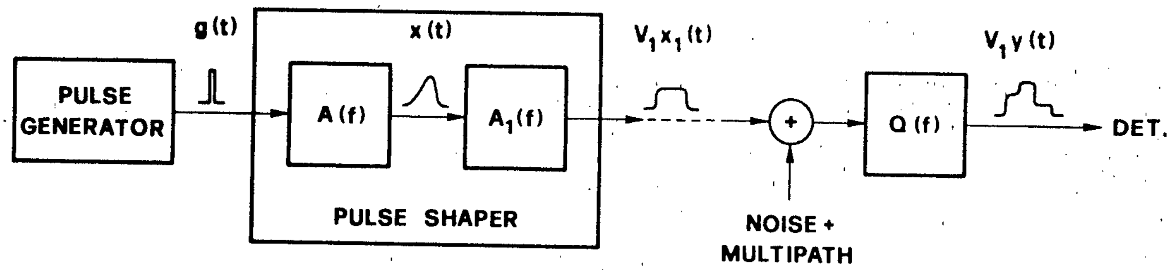

Fig. 3 – Operating principle of the single pulse shaping.

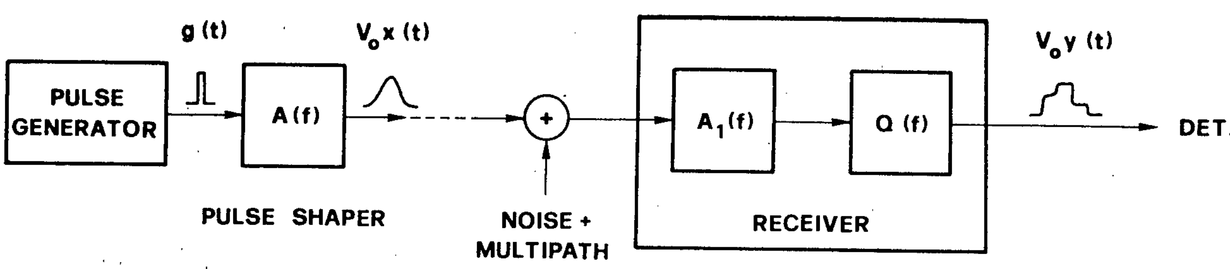

Fig. 4 – Operating principle of the double pulse shaping.

An shown in the same figures, the two systems have not equal performances with reference to the thermal noise. The high pass network $A_1(f)$ deteriorates the signal-to-noise ratio in the receiver; on the other hand, due to eq. (4), V_0 is greater than V_i for the transponder. In [14] it was demonstrated that, assuming eq. (4) as a constraint, the signal-to-noise ratio for equal $y(t)$ is better for the system in fig. 4 in practical cases. This happens because the block diagram in fig. 4, previously called DPS, generalizes that in fig. 3, to which it reduces in some particular cases.

In the DPS technique the pulse waveform is shaped both in the transmitter (smoothing) and also in the receiver (sharpening). It is then possible to define an optimization procedure in order to determine the most appropriate functions for the networks $A(f)$ and $R(f)$. Before going on, it is important to emphasize that this method yields a system without the disadvantages mentioned above.

In order to define the criteria for comparing the performance of different systems, it is necessary to point out that, generally, any method of reducing multipath error deteriorates the signal-to-noise ratio. The latter determines the thermal noise performance of the receiver and can be improved by increasing the transmitted power only in the limits of (4). Assuming a given limit for the multipath error and for the threshold-to-noise ratio at the detection, a minimum value of signal-to-noise ratio at the input of an ideal receiver can be determined. If the theoretical propagation losses are taken into account in the key-points of the landing, it is possible to determine the minimum power to be transmitted. This value, if compared with the one derived from (4), results in a margin M, which can be assumed as a reasonable parameter to compare different, but otherwise equivalent, solutions. In fact, this margin is useful to cope with the impairments in transmission (imperfect frequency domain shaping), in propagation (fading, ground effects, etc.) and in the receiver (noise figure, etc.).

In conclusion, it is important to emphasize that the DPS technique yields an optimization procedure, which maximizes M and yields better performance with respect to the noise, but is at the same time, able to yield a system with the highest interoperability, larger coverage and unified r.f. pulse for CTOL and VTOL applications. These features are definitely the most important ones.

4. SIGNAL DETECTION AND ERROR COMPUTATION

Let us now concentrate our attention on the problem of detection in order to evaluate error performance.

The Delay Attenuate and Compare circuit (DAC hereafter), shown in fig. 5, has been chosen as a pulse arrival time detector.

The comparator gives an output pulse in the instant t_u defined by the equation:

$$u(t_u - \tau_d) - \frac{u(t_u)}{A_d} = 0 \tag{14}$$

where τ_d and A_d are the delay and the attenuation characterizing the DAC circuit.

This circuit allows us to determine the TOA without needing to determine the maximum value of $u(t)$.

In the absence of disturbances, relations (7) and (8) hold; therefore the *ideal* TOA, t_s, is defined by the equation:

$$y(t_s - \tau_d) - \frac{y(t_s)}{A_d} = 0 \tag{15}$$

Then the measurement error is expressed by;

$$\Delta r = (t_u - t_s)\,\frac{c}{2} \tag{16}$$

In order to evaluate the multipath error it is worthwhile distinguishing two different kinds of multipath:

– *diffuse multipath*: it arises from scattering due to the presence of many irregular surfaces; it is present in all directions and exhibits characteristics that are similar to those of thermal noise (with a power proportional to V_0^2); it influences pratically only the CMN;

– *specular multipath*: it arises from reflection in smooth surfaces and is present only in some directions; it is particularly dangerous because it can reach a power comparable with that of the direct wave, and it is a strong source of PFE.

Therefore in the following only the specular multipath is taken into account for system design.

In the presence of a certain number m of echoes, relation (7) becomes:

$$v_R(t) = V_0 \sum_{i}^{m} \frac{y(t - \tau_i)}{A_i} \cos(\omega_0 t + \varphi_i), \tag{17}$$

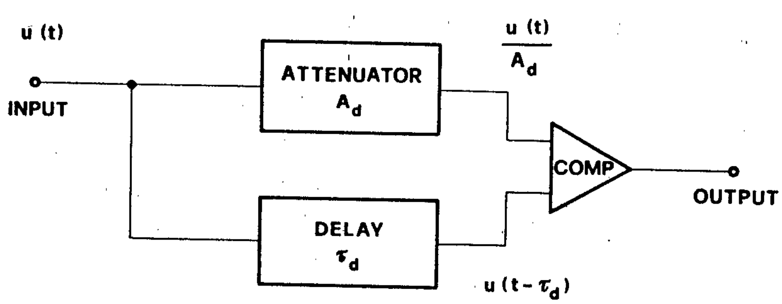

Fig. 5 – Block diagram of the Delay Attenuate and Compare circuit (DAC).

where the meaning of the symbols A_i, τ_i and φ_i is evident.

The complex envelope $i_R(t)$ of $v_R(t)$ may be written, by taking out the useful term

$$(18) \qquad i_R(t) = \frac{V_0}{A_0} e^{j\varphi_0}\left[y(t-\tau_0) + \sum_{1}^{m} {}_i\, \rho_i\, y(t-\tau_i) e^{j\chi_i}\right]$$

where

$$(19) \qquad \rho_i = \frac{A_0}{A_i} \qquad \chi_i = \varphi_i - \varphi_0 \qquad i = 1, 2, \ldots, m.$$

The output signal of the amplitude demodulator is given by

$$(20) \qquad u(t) = |i_R(t)|$$

A computer program has been developed which allows us to evaluate the error Δr by means of (14), (15), (16), (18), (19) and (20) for every combination of parameters ρ_i, τ_i and χ_i.

In order to estimate the measurement precision of any proposed system, it is necessary to refer to the error which occurs with a well-defined echo model, as we stated at the end of section 2. We referred to the model suggested by the Federal Aviation Administration (FAA) [15] which considers only one reflected signal with relative amplitude $\rho_1 = \rho = -6\ dB$; delay τ_1, admitting of any value not lower than τ_0; and any relative phase $\chi_1 = \chi$.

As a matter of fact, it is necessary to assume the worst case for that model as the error of the system.

As far as the thermal noise effects are concerned, the following may be observed. The solution of equation (14) does not change if the signal $u(t)$ is multiplied by an arbitrary coefficient, then even the smallest signal of the DAC input can give rise to a comparator output pulse. In particular, the thermal noise can generate, also in the absence of an useful signal, these pulses (hereafter called false alarms).

Many circuits are being examined in order to avoid false alarms. The simplest one in principle is shown in fig. 6.

In this circuit an output pulse is validated if both the following relations hold at the same time:

$$(21) \qquad \begin{cases} u(t_u - \tau_d) - \dfrac{u(t_u)}{A_d} = 0 \\ u(t_u) > V_s \end{cases}$$

The reference threshold V_s must be chosen in such a way that when only the desired signal is present both (21) hold; in other words, bearing in mind (7) and (15), $y(t)$ must overcome the threshold level *before* the instant t_s defined by (15) and therefore

$$(22) \qquad V_s < \frac{V_0}{A_0} y(t_s)$$

within the converage.

In this case it is easy to verify that both (21) hold also in the presence of multipath, provided that the delays of the echoes are greater than those of the direct signal ($\tau_i > \tau_0$).

It is somewhat difficult to make precise estimate of the false alarm rate for several validation circuits. A detailed analysis of this problem will be the object of a paper to be published shortly [16]. However, for the purpose of this work, it is sufficient to observe that the probability P_u of having $u(t) > V_s$ represents an upper bound for the false alarm probability. In order to have $P_u \leqslant 10^{-6}$ it is necessary to have a threshold to noise ratio of about 14.4 dB; in the following we refer to this value, which represents a very conservative limit with respect to every solution to be adopted in practice.

In order to calculate the thermal noise error, it is necessary to consider, in consistence with the standard procedure exposed in the section 2, that at the DAC input only the useful signal and the noise are present. Therefore

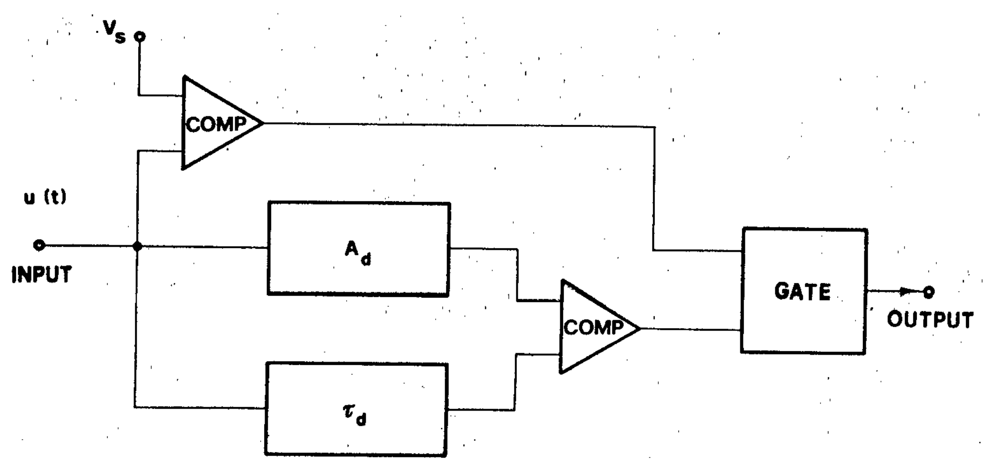

Fig. 6 – DAC circuit with a comparator for avoiding false alarms.

$$v_R(t) = \frac{V_0}{A_0} y(t) \cos \omega_0 t + N(t)$$

$$(23) \qquad u(t) = \left| \frac{V_0}{A_0} y(t) + n(t) \right|$$

where $n(t)$ represents the complex envelope of noise $N(t)$, and τ_0 and φ_0 have been placed equal to zero without loss of generality.

The error Δr, computable by (16) and (23), is a random variable and the determination of its probability distribution is somewhat difficult on account of the nonlinear operation performed by the amplitude demodulator.

The problem can be drastically simplified if we are allowed to assume the signal-to-noise ratio $\gg 1$.

In this case, by introducing the in-phase and in-quadrature components of the noise

$$(24) \qquad n(t) = a(t) + jb(t),$$

it is possible to write

$$(25) \qquad u(t) \simeq \frac{V_0}{A_0} y(t) + a(t)$$

As well-known, $a(t)$ is a gaussian random variable.

Then (14) becomes

$$(26) \qquad \frac{V_0}{A_0}\left[y(t_u - \tau_d) - \frac{y(t_u)}{A_d}\right] + \left[a(t_u - \tau_d) - \frac{a(t_u)}{A_d}\right] = z(t_u) + \nu(t_u) = 0$$

In conclusion, the problem has been reduced to that of the zero crossing of signal $z(t)$ in the presence of *gaussian* noise $\nu(t)$.

Therefore, the error has a null mean value and its variance, again under the hypothesis of high signal-to-noise ratio, can be written [17], [18]

$$(27) \qquad E[\Delta r^2] = \frac{E[\nu^2]}{[\dot{z}(t_u)]^2} \frac{c^2}{4}$$

It is convenient to introduce the following parameters

- $N = E[N^2(t)] = E[a^2(t)]$: noise variance
- $r(\tau) = \dfrac{E[a(t)\,a(t+\tau)]}{N}$: correlation coefficient of the noise component $a(t)$
- y_M : maximum value of $y(t)$
- $\dfrac{S}{N} = \dfrac{V_0^2 y_M^2}{A_0^2 N}$: peak signal-to-noise ratio at the DAC input.

Now the thermal noise error e_N can be expressed by

$$(28) \qquad e_N = 2\sqrt{E(\Delta r^2)} = c \sqrt{\frac{N}{S}} \frac{\sqrt{1 + 1/A_d^2 - \dfrac{2r(\tau_u)}{A_d}}}{\dfrac{1}{y_M}[\dot{y}(t_u - \tau_d) - \dot{y}(t_u)/A_d]}$$

Relation (28) allows us to calculate the thermal noise error as a function of the signal-to-noise ratio. This has been obtained by means of some approximations, but the search for a more precise formula seems unnecessary, because we have verified that in practical cases the signal-to-noise ratio that gives rise to an acceptable false alarm probability also assures the validity of the assumption made to derive (28).

5. SYSTEMS BASED ON THE DPS TECHNIQUE

We have made the following choices:

– the pulse generator provides waveform $g(t)$ of the piecewise linear type;

– the pulse shaper is made up of two cascade simple tuning cells, with transfer function

$$(29) \qquad A(f) = \frac{1}{1 + j\dfrac{f}{B_1}} \cdot \frac{1}{1 + j\dfrac{f}{B_2}};$$

– the transmitted envelope, $x(t)$, is equal for the interrogator and the transponder in every case;

– the low-pass equivalent of the receiver is made up of a 4-pole Butterworth filter with bandwidth B_3, followed by the high-pass network:

$$(30) \qquad A_1(f) = \frac{1 + j\dfrac{f}{B_4}}{1 + j\dfrac{f}{B_5}}.$$

By making these choices we obtain circuits which satisfy all the contraints imposed, and are particularly simple to implement.

In order to verify whether a system meets the precision requirements, it is necessary to enumerate all the possible error sources and divide the allowable error among them, settling the so-called "error budget" which is not within the scope of this paper. Thus, to demonstrate that the proposed systems can meet the precision requirements, we imposed the following limitation for the PFE component of multipath error (the most unfavourable):

$\Delta r \leqslant 10\ m$ for CTOL applications,

$\Delta r \leqslant 4\ m$ for VTOL applications

for both the radio links.

In this way, also in those cases where the up-link and down-

-link errors add linearly, a sufficient margin is left to cope with the instrumentation errors [20] (we recall that the operational requirement specifies that PFE $\leqslant 30\ m$ for CTOL systems and PFE $\leqslant 12\ m$ for VTOL systems).

The optimization criteria adopted for selecting the system parameters is that introduced at the end of section 3, which maximizes the margin M.

Finally we considered it unnecessary to adopt different system parameters for the interrogator and the transponder.

In the following we report a summary of the results obtained.

5.1. *Transmitter*

The optimum values for parameters B_1 and B_2 in (29) are:

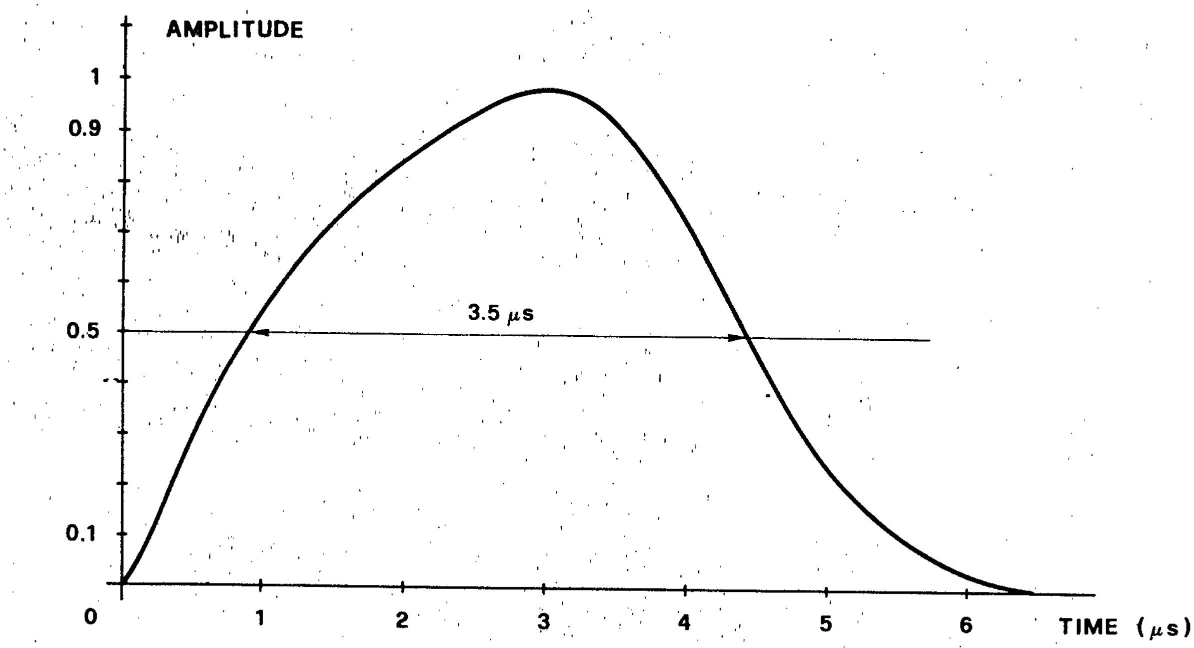

Fig. 7 – Transmitted pulse shape.

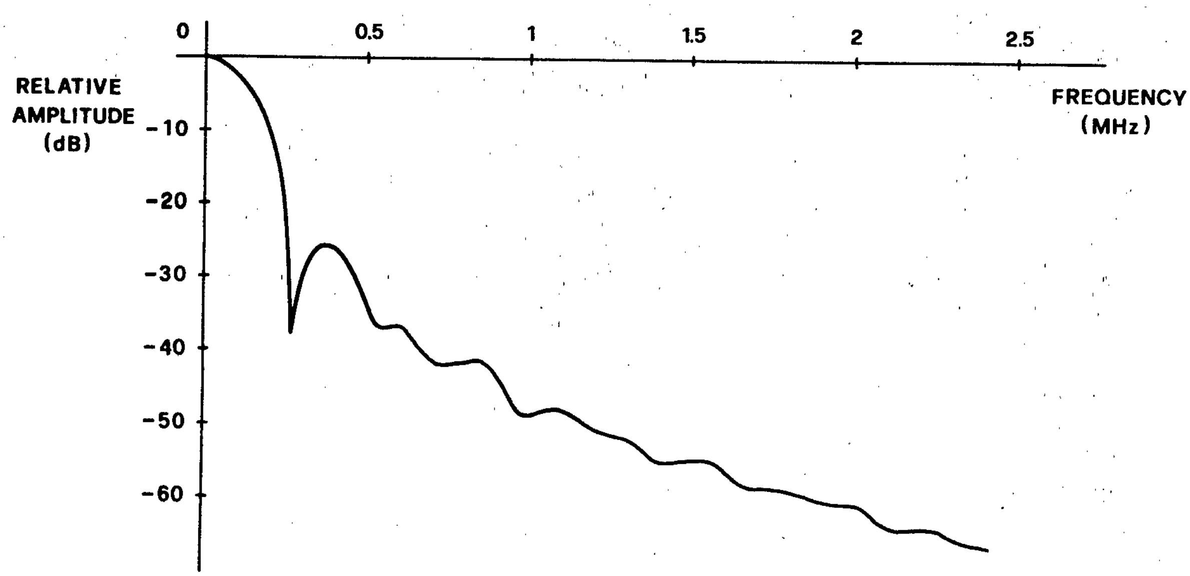

Fig. 8 – Power density spectrum of the transmitted pulse.

$B_1 = 0.115$ MHz

$B_2 = 1.4$ MHz

Correspondently the transmitted envelope $x(t)$ takes the form shown in fig. 7 with the following parameters;

$d = 3.5\ \mu s$

$t_r = 2\ \mu s$

$t_f = 2.5\ \mu s$

The transmitted signal spectrum is shown in fig. 8. The maximum effective radiated power permitted under the ICAO constraints expressed by (4) results

$$\text{ERP} = 60.7\ dBm$$

5.2. *Receiver for CTOL system*

In the design of this receiver we imposed a further constraint: the adoption of a 1 MHz bandwidth for the 4-pole Butterworth filter.

This drastically reduces the disturbance due to the adjacent channel interference.

Owing to the above choices, the optimum high pass network

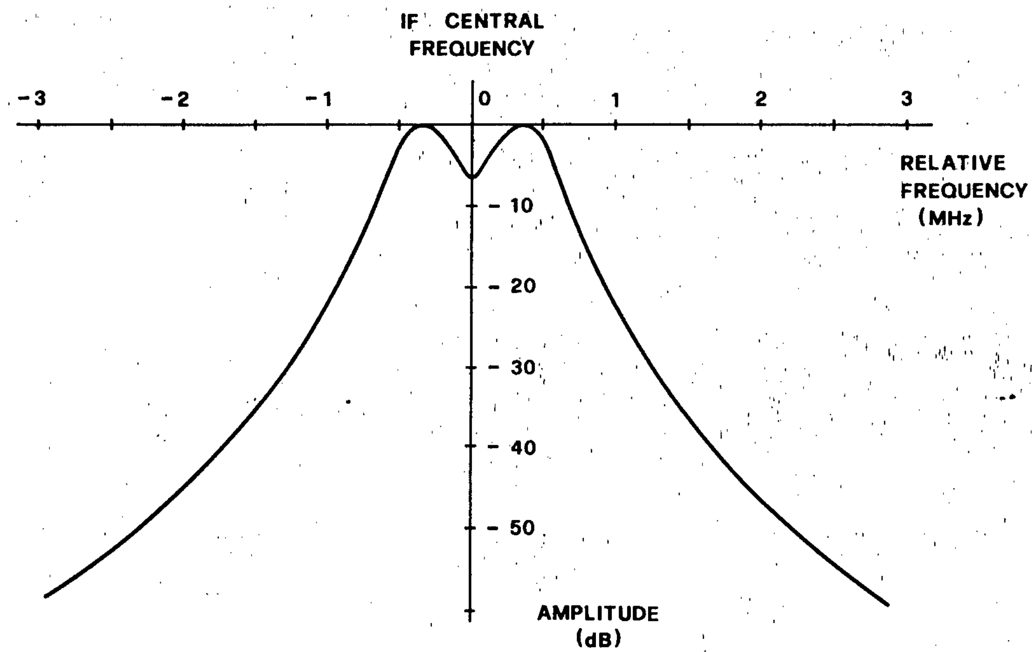

Fig. 9 – Characteristic of the CTOL system receiver filter.

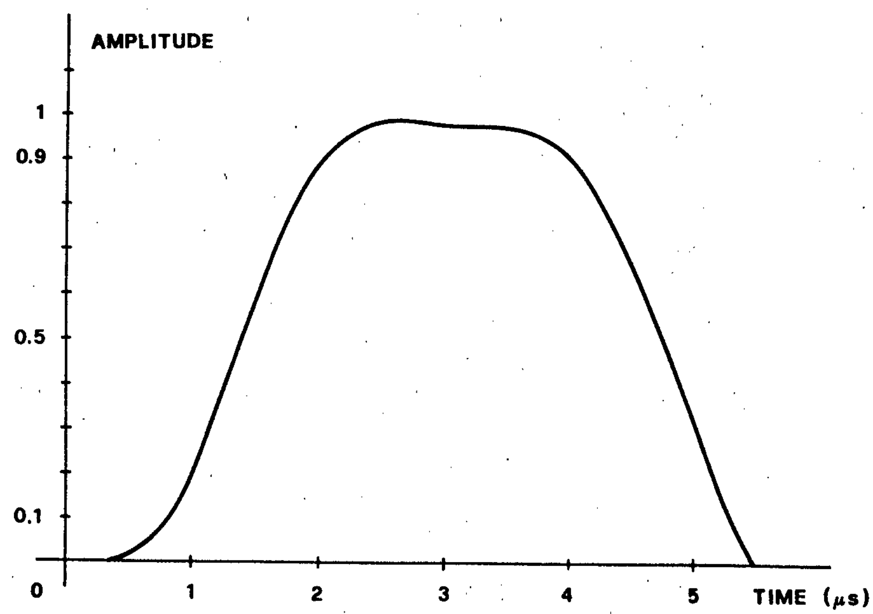

Fig. 10 – Received pulse shape for the CTOL system.

defined by (30) is characterized by

$$B_4 = 0.115 \text{ MHz}$$
$$B_5 = 0.3 \text{ MHz}$$

The resulting amplitude characteristic of the receiving filter is shown in fig. 9.

The received pulse envelope $y(t)$, after the linear operation performed by the receiving filter, takes the form shown in fig. 10, in which it has been normalized with respect to its maximul value.

The most suitable parameters for the DAC network are the following:

$$\tau_d = 320 \; ns$$
$$A_d = 3$$

to which the following crossing levels correspond

$$y(t_s) = 0.3 \, y_M$$
$$y(t_s - \tau_d) = 0.1 \, y_M,$$

where t_s is the ideal crossing instant defined by (15). A suitable threshold level V_s can be placed at 25% of $y_M \, V_0/A_0$ at the maximum distance (see eq. 22).

In fig. 11 the performance of the system in the presence of multipath is illustrated. It shows the error caused by a single echo, with relative amplitude $\rho = -6 \; dB$, as a function of the delay $\tau = \tau_1 - \tau_0$, for the worst values of the carrier relative phase which are $\chi = 0$ and $\chi = \pi$. The maximum error occurs for $\chi = \pi$, $\tau = 180$ ns and its value is

$$\Delta r \simeq 10 \; m.$$

As far as the thermal noise effects are concerned, it is necessary to distinguish the up-link from the down-link, because it is reasonable that the antenna gains and the receiver noise figures are different. The most critical link is the ground-to-air one, as can easily be seen. It is therefore appropriate to calculate the false alarm margin at the limit of the coverage (22 nautical miles) for this link.

With the aforesaid value of V_s, in order to obtain a threshold-to-noise ratio of 14.4 dB, it is necessary to have at the DAC input

$$\frac{S}{N} = 26.4 \; dB$$

Then in ideal propagation conditions, with an aircraft antenna with a 0 dB gain and a noiseless receiver, an effective radiated power of 38.7 dBm is required in transmission.

In conclusion, a margin

$$M = 22 \; dB$$

is left, which is amply sufficient to cope with the receiver noise figure and the propagation impairments.

In order to calculate the noise error we apply (28), assuming $\frac{S}{N} = 26.4 \; dB$ at the limit of the coverage and therefore $\frac{S}{N} = 44.4 \; dB$ at the Reference Datum.

The resulting error

$$e_N = 10 \; m$$

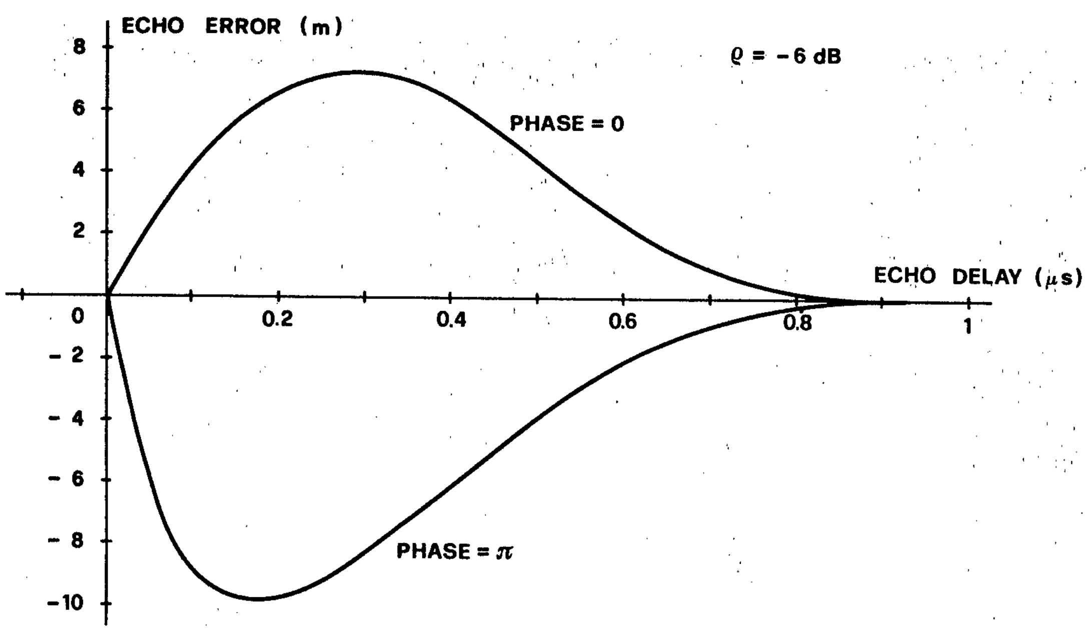

Fig. 11 – 1-way echo error versus echo delay for the CTOL system, for the worst values of the carrier relative phase and assuming a relative amplitude $\rho = -6$ dB.

is widely accettable because the numerical filtering reduces it by a factor of about 5 [19], [20]. This confirms the statment, made at the end of section 4, that the transmitted power lower bound arises from false alarm probability.

On account of the more severe precision requirements, this receiver must operate with a larger bandwidth than that previously described. Thus, we chose a bandwidth of 3 MHz for the 4-pole Butterworth filter.

The optimum parameters for the high pass network are:

$$B_4 = 0.115 \text{ MHz}$$

$$B_5 = 1.1 \text{ MHz}$$

The corresponding amplitude characteristic of the receiving filter and the relative normalized received pulse are shown respectively, in figs. 12 and 13. The most suitable choice for the DAC parameters is:

$$\tau_d = 120\, ns$$

$$A_d = 3,$$

to which correspond

$$y(t) = 0.3\, y_M$$

$$y(t_s - \tau_d) = 0.1\, y_M.$$

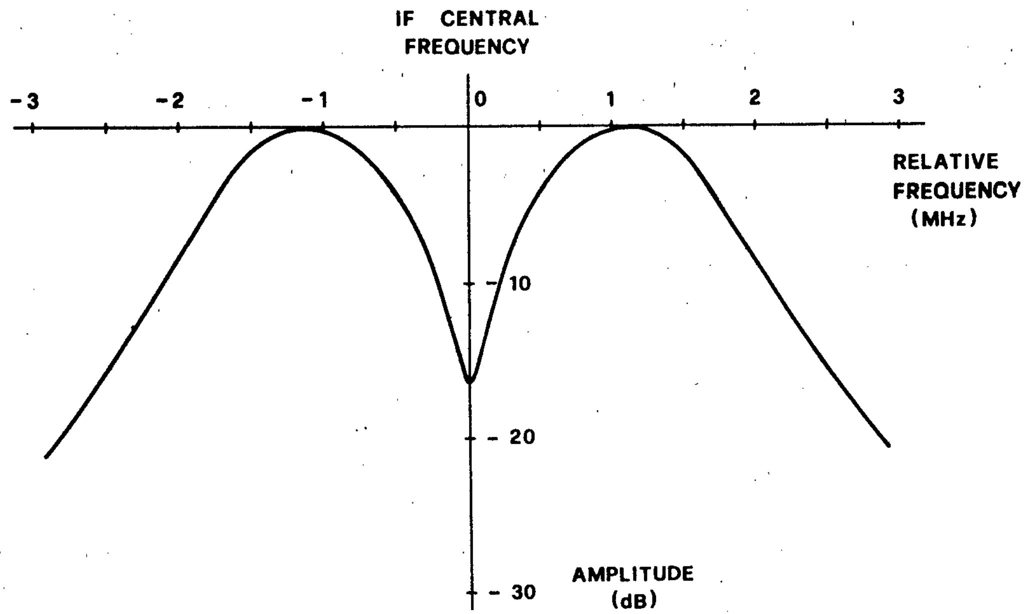

Fig. 12 – Characteristic of the VTOL system receiver filter.

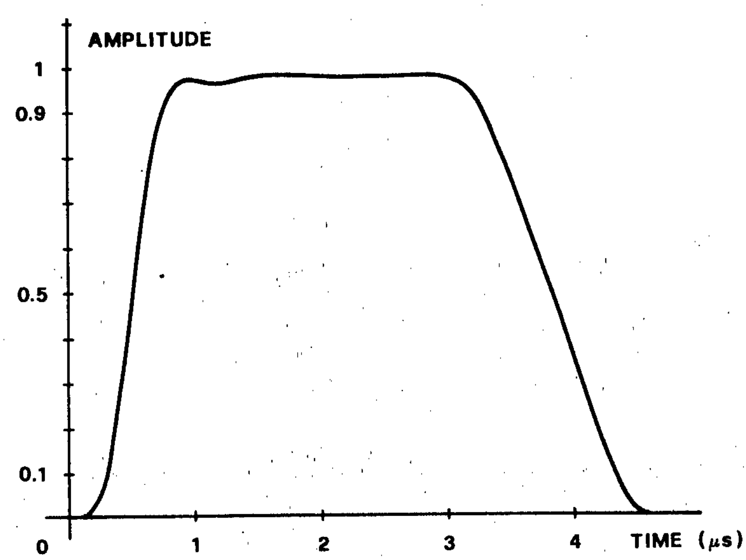

Fig. 13 – Received pulse shape for the VTOL system.

In fig. 14 the curves relative to the multipath error, analogous to those of fig. 11 are shown. The maximum echo error is

$$\Delta r \simeq 4\ m$$

As far the thermal noise margin M is concerned, it seems not significant to repeat the procedure used for the CTOL system, on account of the non complete definition of the operational requirements (in particular the limit of the converge). Nevertheless in the next section the more interesting performance of the studied systems will be quoted.

Before concluding this section, the following considerations may be made.

Experimental and theoretical analyses have shown that the circuits required by the proposed systems are not critical [5]. In fact, the circuit parameters may vary up to 10% without giving rise to considerable performance degradation.

Besides, a mistuning between transmitter carrier and receiver filter frequencies of about a hundred *KHz* can be tolerated.

Finally, we recall that at LCF a base band model of the VTOL system has been realized in order to validate the system concept. The measurements made, partially reported in paper [21], have fully confirmed the theoretical results. In particular, this experimental work has proved that the accuracy required is achieved, the interoperability is guaranteed, and the circuits are not critical and economically feasible.

6. THE ITALIAN DME-P PROPOSAL BASED ON THE DPS TECHNIQUE

On the basis of the DPS technique and of the previously described optimization a DME-P system was completely defined and presented as the Italian proposal to proper ICAO bodies.

The system concept, the pulse shapes, the filter characteristics were illustrated in the previous sections. In the following the complete performance of the system is summarized in tables concerning power budget and error budget.

In table 1 and 2 the error budgets for the CTOL and VTOL systems are quoted. A refinement of values is still in progress, following the work of ICAO bodies; only small changes are in discussion, thus we present the values of the original proposal submitted.

In order to fully specify the characteristics of the subsystems a complete power budget for both the links (ground to air and viceversa) is necessary. This is shown in tables 3, 4, 5, 6 where all the different sources of loss are explicitely mentioned. In the ground to air link the possibility to use only a Butterworth filter instead of the more complicate of figs. 9 and 12 is taken into account at distances were the high accuracy is not necessary. Owing to the different insertion loss in the two cases, different received video noise are quoted. The transponder is not allowed to do that because of hardware complexity and that possibility is excluded in the air-to-ground link. The power values are quoted for the key-points of the landing. Values for CTOL applications at 220 *NM* are referred to the navigation and are inserted for completeness.

The use of the DPS technique results in a system with many advantages with respect to the conventional ones; these advantages are here summarized with reference to CTOL applications:

– narrow receiver bandwidth (system more protected against the interference);

– narrow transmission bandwidth (lower power content in the adjacent channels for the interrogator);

– high permitted ERP for the transponder (the system is capable of satisfying the sensitivity specifications at the limits of converage);

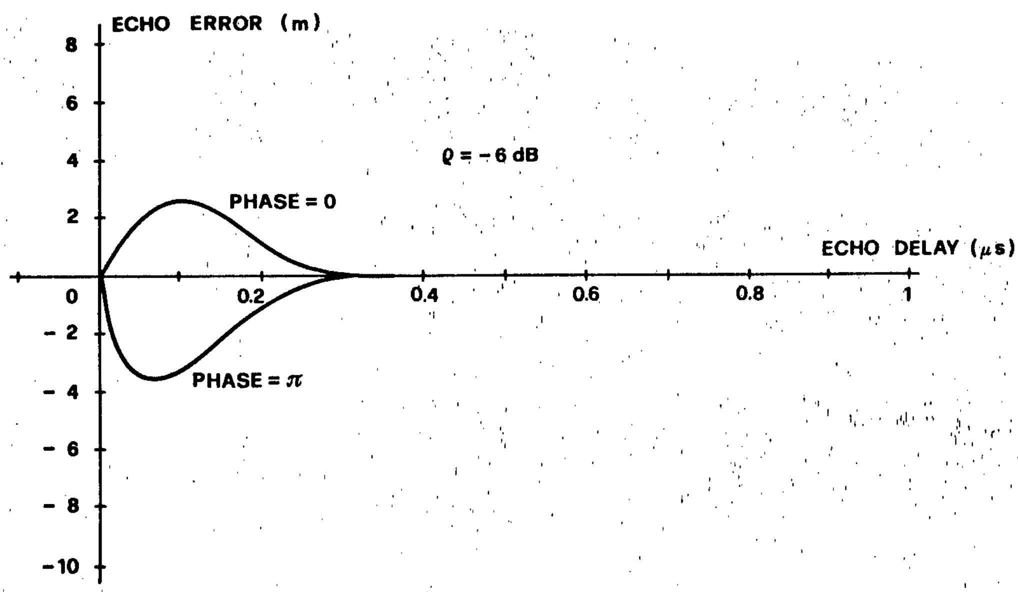

Fig. 14 – 1-way echo error versus echo delay, analogous to fig. 11, for the VTOL system.

Table 1 – Error budget for the CTOL system.

	PFE (m)	CMN (m)	
		RAW	FILTERED
INSTRUMENTATION	22.3	45	9.0
MULTIPATH	20	14	2.8
THERMAL NOISE	1	5.6	1.1
GARBLE	1	1	0.2
TOTAL	30		9.5

Table 2 – Error budget for the VTOL system.

	PFE (m)	CMN (m)	
		RAW	FILTERED
INSTRUMENTATION	8.9	.5	1
MULTIPATH	8	5.6	1.1
THERMAL NOISE	0.5	1.3	0.25
GARBLE	1	3	0.6
TOTAL	12		1.6

Table 3 – Power budget for the CTOL ground-to-air link.

		22 NM	7NM	REFERENCE DATUM	ROLL OUT
ERP	dBm	57.5	57.5	57.5	57.5
Ground multipath loss	dB	– 5	– 3	– 4	– 17.3
Antenna pattern loss	dB	– 4	– 2	– 5	– 5
Path loss	dB	– 125	– 115	– 107	– 103
Monitor loss	dB	– 1	– 1	– 1	– 1
Polarization + rain loss	dB	– 1	– 1	0	0
Received signal at aircraft	dBm	– 78.5	– 64.5	– 59.5	– 68.8
A/C antenna gain	dB	0	0	3	3
A/C cable loss	dB	– 4	– 4	– 4	– 4
Received signal at interrogator	dBm	– 82.5	– 68.5	– 60.5	– 69.8
Received video noise					
IF BW = 0.8 without DPS filter	dBm	– 109			
IF BW = 0.8 with DPS filter	dBm		– 104	– 104	– 104
(noise figure = 9 dB)					
Signal-to-noise ratio (video)	dB	26.5	35.5	43.5	34.2

– high accuracy obtainable without critic system parameters (the DAC is a critic network if the crossing occurs at a very low threshold).

Moreover if the interoperability of CTOL and VTOL application is considered, this system is the only system which uses the same transmitted pulse shape for both the applications; this is a very important feature with useful consequences also from the industrial point of view.

7. FINAL DISCUSSION

The purpose of this paper has been to describe the DPS technique and its advantages where applied to the DME-P of

Table 4 – Power budget for the CTOL air-to-ground link.

		220 NM (DME-N TRAN.)	22 NM	7 NM	REFERENCE DATUM	ROLL OUT
Interrogator transmitter power	dBm	57	57	57	57	57
A/C cable loss	dB	−4	−4	−4	−4	−4
A/C antenna gain	dB	3	0	0	3	3
ERP	dBm	56	53	53	56	56
Antenna pattern loss	dB	−3	—	—	—	—
Path loss	dB	−145	−125	−115	−107	−103
Ground multipath loss	dB	−5	−5	−3	−4	−17.3
Polarization + rain loss	dB	−2	−1	−1	0	0
Received signal at transponder antenna	dBm	−99	−78	−66	−55	−64.3
Ground antenna gain	dB	8	8	8	8	8
Pattern loss	dB	−4	−4	−2	−5	−5
Cable loss	dB	−3	−3	−3	−3	−3
Received signal at transponder	dBm	−98	−77	−63	−55	−64.3
Received video noise						
IF BW = 0.8 with DPS filter (noise figure = 6 dB)	dBm		−107	−107	−107	−107
IF BW = 0.4 (en-route transponder) (noise figure = 9 dB)	dBm	−112				
Signal-to-noise ratio (video)	dB	14	30	44	52	42.7

MLS system. This results in the complete definition of two systems for CTOL and VTOL applications, with better performance for many technical aspect in comparison with competitors.

The ICAO process of definition of the DME-P is approaching its conclusion, but is still in evolution. Therefore, the system parameters must not be considered fixed. In particular, some changes, possibly of no small importance, could be suggested by the final choice of the reference traffic scenario for the MLS. If that scenario is very crowded with ground and airborne equipment in a restricted area, further studies on the interference effects must be conducted.

Hardware and industrial problems are not emphasized in this paper; nevertheless, experimental work has been carried out at the same time as theoretical studies. In particular the interrogator transmitter, the VTOL i.f. filter, both the r.f. front-end, the detection network were realized. The experimental tests are in agreement with the computations made and all the foundamental networks have shown not to be critical. This work can be considered to be a validation of the original aspects of DPS. Some hardware problems need to be studied and developed further, but these are not typical aspects of DPS, while industrial policy suggests waiting for the final decision on the system before concluding work. According to the ICAO conclusion a complete experimental apparatus will be constructed by LCF with the aid of the considerable experience gained in this research and the existence of the industrial background gained by a company which has been manufacturing the conventional ground equipment for a very long time.

Tabel 5 – Power budget for the VTOL ground-to-air link.

		22 NM	2.5 NM	INITIATION OF DECELERATED APPROACH 3000 FT
ERP	dBm	57.5	57.5	57.5
Ground multipath loss	dB	−3	−3	−3
Path loss	dB	−125	−105	−93
Monitor loss	dB	−1	−1	−1
Polarization + rain loss	dB	−1	−1	0
Received signal at aircraft	dBm	−72.5	−52.5	−39.5
A/C antenna gain	dB	0	0	0
A/C cable loss	dB	−2	−2	−2
Received signal at interrogator	dBm	−74.5	−54.5	−41.5
Received video noise				
IF BW = 0.8 without DPS filter	dBm	−109		
IF BW = 2.2 with DPS filter	dBm		−90	−90
(noise figure = 9 dB)				
Signal-to-noise ratio	dB	34.5	35.5	48.5

Table 6 – Power budget for the VTOL air-to-ground link.

		22 NM	2.5 NM	INITIATION OF DECELERATED APPROACH 3000 FT
Interrogator transmitter power	dBm	57	57	57
A/C cable loss	dB	−2	−2	−2
A/C antenna gain	dB	0	0	0
ERP	dBm	55	55	55
Path loss	dB	−125	−105	−93
Ground multipath loss	dB	−3	−3	−3
Polarization + rain loss	dB	−1	−1	0
Received signal at transponder antenna	dBm	−74	−54	−41
Ground antenna gain	dB	5	5	5
Cable loss	dB	−3	−3	−3
Received signal at transponder	dBm	−72	−52	−39
Received video noise				
IF BW = 2.2 with DPS filter	dBm	−93	−93	−93
(noise figure = 6 dB)				
Signal-to-noise ratio (video)	dB	21	41	54

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